PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-203892
(43)Date of publication of application : 18.07.2003

(51)Int.Cl. H01L 21/304

(21)Application number : 2002-311928
(22)Date of filing : 25.10.2002

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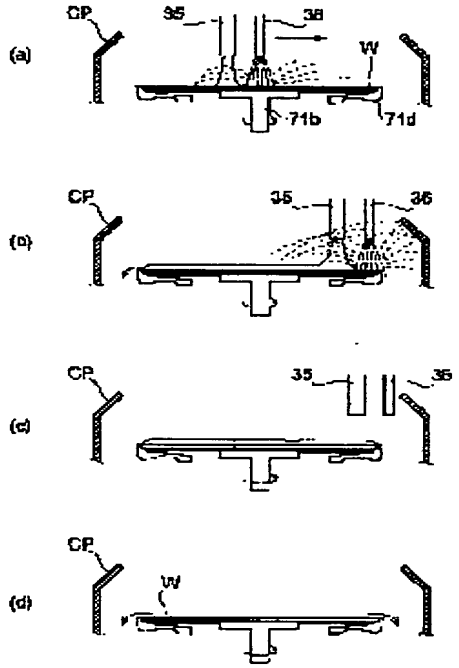
(30)Priority
Priority number : 2001336461 Priority date : 01.11.2001 Priority country : JP

(54) SUBSTRATE-CLEANING DEVICE AND SUBSTRATE CLEANING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a substrate-cleaning device and a cleaning method which can prevent particles from adhering to a substrate, irrespective of the substrate being either a hydrophilic or hydrophobic.
SOLUTION: A cleaning solution delivered from a two-fluid nozzle 36 is made to splash back in the inside of a cup CP, and turns into a mist condition to scatter to a center side of a wafer W, but since a rinse agent is supplied to the wafer W by a rinse nozzle 35 to form a water film 51, even if mist adheres to the water film 51, the mist will not adhere directly to the wafer surfaces. As a result, it is possible to prevent particles contained in the mist from adhering on the wafer W and to prevent adverse influences on the wafer W.



LEGAL STATUS

[Date of request for examination] 01.12.2003

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] The substrate washing station characterized by providing the washing nozzle which can prepare the substrate top which rotates with the rotation attaching part which holds a substrate pivotable in the direction of a path movable, and carries out the regurgitation of the penetrant remover, and the liquid supply nozzle which supplies a liquid on a substrate in the case of washing by said washing nozzle, and forms liquid membrane on a substrate.
[Claim 2] The liquid supplied by said liquid supply nozzle on a substrate in a substrate washing station according to claim 1 is a substrate washing station characterized by supplying the center-of-rotation side of a substrate from said washing nozzle.
[Claim 3] The substrate washing station characterized by providing further a means to control to start supply of the liquid by said liquid supply nozzle in a substrate washing station according to claim 1 or 2 when said washing nozzle moves near the periphery section of a substrate.
[Claim 4] It is the substrate washing station characterized by said substrate being a hydrophobic substrate in a substrate washing station given in any 1 term among claim 1 to claims 3.
[Claim 5] It is the substrate washing station characterized by the liquid supplied by said liquid supply nozzle on a substrate being a rinse in a substrate washing station given in any 1 term among claim 1 to claims 4.
[Claim 6] The rinse supplied by said liquid supply nozzle on a substrate in a substrate washing station according to claim 5 is a substrate washing station characterized by being pure water.
[Claim 7] It is the substrate washing station characterized by said penetrant remover being the interflow object of inert gas and a liquid in a substrate washing station given in any 1 term among claim 1 to claims 6.
[Claim 8] It is the substrate washing station characterized by arranging said liquid supply nozzle movable in one with said washing nozzle which moves in a substrate washing station given in any 1 term among claim 1 to claims 7.
[Claim 9] It is the substrate washing station characterized by arranging said liquid supply nozzle in a substrate washing station according to claim 8 at a substrate core side to said washing nozzle which moves.
[Claim 10] It is the substrate washing station characterized by the distance of said washing nozzle and a liquid supply nozzle being 5mm - 80mm in a substrate washing station according to claim 8.
[Claim 11] The substrate washing station characterized by providing further a means to control the flow rate of the liquid supplied to the periphery section of said substrate to make [more] it than the flow rate of the liquid supplied by the substrate core in a substrate washing station given in any 1 term among claim 8 to claims 10.
[Claim 12] The substrate washing station characterized by providing further a means to control the rate of a liquid supply nozzle in case said liquid is supplied to the periphery section of said substrate to make it smaller than the rate of the liquid supply nozzle when being supplied by the substrate core in a substrate washing station given in any 1 term among claim 8 to claims 10.
[Claim 13] The substrate washing station characterized by providing further a means to control the rotational frequency of a substrate in case said liquid is supplied to the periphery section of

said substrate to make it smaller than a rotational frequency in case said liquid is supplied by the substrate core in a substrate washing station given in any 1 term among claim 8 to claims 10.
[Claim 14] It is the substrate washing station characterized by the flow rate of the inert gas of said penetrant remover being 10 Nl/min - 200 Nl/min in a substrate washing station according to claim 7.
[Claim 15] It is the substrate washing station characterized by the flow rate of the inert gas of said penetrant remover being 80 Nl/min in a substrate washing station according to claim 14.
[Claim 16] The flow rate of said liquid supplied by said liquid supply nozzle in a substrate washing station according to claim 1 is a substrate washing station characterized by being 0.5 l/min - 1.2 l/min.
[Claim 17] It is the substrate washing station characterized by the rate of said liquid supply nozzle being 5 mm/sec - 30 mm/sec in a substrate washing station according to claim 16.
[Claim 18] It is the substrate washing station characterized by the rotational frequency of said substrate being 300rpm - 5000rpm in a substrate washing station according to claim 1.
[Claim 19] The washing nozzle which can prepare the rotating substrate top in the direction of a path movable, and carries out the regurgitation of the penetrant remover to the rotation attaching part which holds a substrate pivotable, The 1st liquid supply nozzle which is arranged movable in one with said washing nozzle which moves, supplies a liquid on a substrate in the case of washing by said washing nozzle, and forms liquid membrane on a substrate, The substrate washing station characterized by providing the 2nd liquid supply nozzle which supplies a liquid to the position of said substrate and forms liquid membrane on a substrate with said 1st liquid supply nozzle in the case of washing by said washing nozzle.
[Claim 20] The substrate washing station characterized by providing a means to control to supply the liquid by said 2nd liquid supply nozzle in a substrate washing station according to claim 19 when said washing nozzle moves near the periphery section of said substrate.
[Claim 21] The liquid supplied by said 2nd liquid supply nozzle in a substrate washing station according to claim 20 is a substrate washing station characterized by supplying the core of a substrate.
[Claim 22] The substrate washing approach characterized by providing the process which carries out the regurgitation of the penetrant remover on the rotating substrate, and the process which supplies a liquid and forms liquid membrane on a substrate on this substrate in the case of said washing process.
[Claim 23] It is the substrate washing approach characterized by providing the washing nozzle which said penetrant remover is the interflow object of inert gas and a predetermined liquid in the substrate washing approach according to claim 22, and carries out the regurgitation of this penetrant remover.
[Claim 24] It is the substrate washing approach which said washing nozzle can prepare said rotating substrate top in the direction of a path movable in the substrate washing approach according to claim 23, and is characterized by supplying said liquid to a core side from the location on the substrate with which a penetrant remover is breathed out in the case of migration of said washing nozzle.
[Claim 25] The substrate washing approach characterized by providing further the process which starts supply of said liquid in the substrate washing approach according to claim 24 when said washing nozzle moves near the periphery section of said substrate.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the substrate washing station and the substrate washing approach of washing a semi-conductor wafer substrate in manufacture of a semiconductor device.
[0002]
[Description of the Prior Art] It is necessary to maintain highly the cleanliness of the front rear face of a semi-conductor wafer (henceforth a "wafer"), especially the front face of a wafer in which a semiconductor device is formed, and, for this reason, washing on the rear face of front of a wafer is performed before and behind various manufacture processes in manufacture of a semiconductor device.
[0003] In a photolithography process, washing on the rear face of front of a wafer is indispensable especially. For example, holding a wafer in the cup for preventing scattering of a penetrant remover, or collecting and discarding the penetrant remover after use, rotating a wafer within this cup, and supplying a penetrant remover to that wafer top face Scrub washing which removes contaminants, such as particle adhering to a wafer top face, by carrying out both-way migration of the rotating brush between the core of a wafer and the periphery section, contacting a wafer top face is performed.
[0004] Moreover, he carries out jet injection of the interflow object (two fluids) which mixed ultrasonic-cleaning water, and inert gas and pure water for example, not only washing with a rotation brush but on the wafer by the nozzle, and is trying to remove more detailed particle in this scrub washing in recent years. (For example, patent reference 1 reference.) .
[0005]
[Patent reference 1] JP,10-156229,A (drawing 1 etc.).
[0006]
[Problem(s) to be Solved by the Invention] However, when carrying out jet injection of the penetrant removers, such as ultrasonic-cleaning water and two fluids, and washing a wafer, and the wash water of jet injection becomes Myst-like and rebounds by the internal surface of a cup which held especially the wafer, the particle which sprinkled the particle adhering to the internal surface of the cup concerned etc., and was sprinkled in this way adheres to a wafer. That is, originally, although the cup has the function in which prevent that a penetrant remover disperses around, or a penetrant remover flows caudad and falls along with the internal surface of a cup during wafer washing, since there are many flow rates and these wash water has strong injection vigor when wash water, such as ultrasonic-cleaning water and two fluids, is used, it will rebound by the cup internal surface.
[0007] The contact angle over the wafer front face of the penetrant remover which contains the particle adhering to a wafer when the wafer which is a processing object in this case is a wafer of a hydrophilic property is small, and since it will be in the condition of the penetrant remover concerned flowing from a wafer with particle, and being easy to fall, it is satisfactory. However, since ******** is large and wettability is bad when the wafer which is a processing object is a hydrophobic wafer, in spite of being in the middle of the regurgitation of a penetrant remover, a

wafer side is exposed, direct Myst-like particle adheres to a wafer side, and this cannot be removed.

[0008] In view of the above situations, the purpose of this invention is not concerned with a hydrophilic property or one of hydrophobic substrates, but is to offer the substrate washing station which can prevent adhesion of the particle to the substrate top concerned, and the substrate washing approach.

[0009]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the substrate washing station concerning the 1st viewpoint of this invention possesses the washing nozzle which can prepare the substrate top which rotates with the rotation attaching part which holds a substrate pivotable in the direction of a path movable, and carries out the regurgitation of the penetrant remover, and the liquid supply nozzle which supplies a liquid on a substrate in the case of washing by said washing nozzle, and forms liquid membrane on a substrate.

[0010] Since it is washing by breathing out a penetrant remover according to such a configuration, making the liquid membrane of a hydrophilic property form to a substrate on a substrate for example, in being the case where a hydrophobic substrate is used, holding this substrate in a cup and performing washing processing Myst of a penetrant remover which rebounds from this cup adheres on the liquid membrane of the hydrophilic property concerned, and the particle contained in this Myst is discharged by the centrifugal force of the rotating substrate besides a substrate with liquid membrane. Thereby, it can prevent that particle adheres on a direct substrate.

[0011] Here, it is the semantics of forming the film of a hydrophilic property for a substrate front face, saying "form the liquid membrane of a hydrophilic property." That is, it means that a hydrophobic substrate front face becomes a hydrophilic property by forming liquid membrane on a substrate.

[0012] According to the gestalt of 1 of this invention, the liquid supplied by said liquid supply nozzle on a substrate is supplied to the center-of-rotation side of a substrate from said washing nozzle.

[0013] According to the gestalt of 1 of this invention, when said washing nozzle moves near the periphery section of a substrate, a means to control to start supply of the liquid by said liquid supply nozzle is provided further.

[0014] According to the gestalt of 1 of this invention, said substrate is a hydrophobic substrate.

[0015] According to the gestalt of 1 of this invention, the liquid supplied by said liquid supply nozzle on a substrate is a rinse.

[0016] According to the gestalt of 1 of this invention, the rinse supplied by said liquid supply nozzle on a substrate is pure water.

[0017] According to the gestalt of 1 of this invention, said penetrant remover is the interflow object of inert gas and a liquid. Since the discharge pressure and pure water of this gas are made to perform washing processing of a substrate, using pure water as a liquid, using nitrogen gas as this inert gas, the amount of scattering of the penetrant remover by the washing nozzle serves as a situation which Myst tends to generate. In this case, the Myst antisticking effectiveness by liquid membrane formation of this invention is large. Here, the flow rate of the inert gas of a penetrant remover is made into 10 Nl/min - 200 Nl/min. It is 80 Nl/min more preferably.

[0018] According to the gestalt of 1 of this invention, said liquid supply nozzle is arranged movable in one with said washing nozzle which moves. Moreover, said liquid supply nozzle is arranged in this case at a substrate core side to said washing nozzle which moves, and, as for the distance of said washing nozzle and a liquid supply nozzle, it is still more desirable to be referred to as 5mm - 80mm. Thus, even if it is the case where the washing nozzle separates from the substrate periphery section to the outside, for example since permanence was supplied to the substrate core side rather than the location where a liquid supply nozzle is arranged to the substrate core side of the washing nozzle which moves and carries out the regurgitation of the penetrant remover, and a penetrant remover is supplied to a substrate, a liquid supply nozzle always supplies a liquid to the substrate periphery section, and liquid membrane is formed.

Therefore, it can prevent that particle adheres to the substrate periphery section with much rebound-phenomenon Myst from a cup especially. Moreover, the same effectiveness is acquired also when a rinse is used as a liquid.

[0019] According to the gestalt of 1 of this invention, a means to control to make [more] the flow rate of the liquid supplied to the periphery section of said substrate than the flow rate of the liquid supplied by the substrate core is provided further. Or a means to control to make the rate of a liquid supply nozzle in case said liquid is supplied to the periphery section of said substrate smaller than the rate of the liquid supply nozzle when being supplied by the substrate core is provided further. Although the core differs in the rotational speed of a substrate from the periphery section, as a result of being able to make the same the amount of supply of the liquid supplied to per unit time amount on a substrate side as much as possible in a core and the periphery section, the washing engine performance can be made into homogeneity all over a substrate by changing the flow rate of a liquid, or the passing speed of a liquid supply nozzle in this way. Here, the flow rate of a liquid is made into 0.5 l/min - 1.2 l/min, and, as for the rate of a liquid supply nozzle, it is desirable to consider as 5 mm/sec - 30 mm/sec.

[0020] According to the gestalt of 1 of this invention, a means to control to make the rotational frequency of a substrate in case said liquid is supplied to the periphery section of said substrate smaller than a rotational frequency in case said liquid is supplied by the substrate core is provided further. Thus, since it is carrying out adjustable [of the rotational speed of a substrate] corresponding to the supply location of a liquid, as a result of being able to make the same the amount of supply of the liquid supplied to per unit time amount on a substrate side as much as possible in a core and the periphery section, the washing engine performance can be made into homogeneity all over a substrate. Here, as for the rotational frequency of a substrate, it is desirable to be referred to as 300rpm - 5000rpm.

[0021] The rotation attaching part to which the substrate washing station concerning the 2nd viewpoint of this invention holds a substrate pivotable, The washing nozzle which can prepare the rotating substrate top in the direction of a path movable, and carries out the regurgitation of the penetrant remover, The 1st liquid supply nozzle which is arranged movable in one with said washing nozzle which moves, supplies a liquid on a substrate in the case of washing by said washing nozzle, and forms liquid membrane on a substrate, The 2nd liquid supply nozzle which supplies a liquid to the position of said substrate and forms liquid membrane on a substrate with said 1st liquid supply nozzle in the case of washing by said washing nozzle is provided.

[0022] A penetrant remover is breathed out moving the liquid supply nozzle of ** a 1st in one in a washing nozzle according to such a configuration, and making the liquid membrane of a hydrophilic property form on a substrate, liquid membrane formation near the washing nozzle is ensured especially, a liquid is further supplied to for example, a substrate core by the liquid supply nozzle of ** a 2nd, and liquid membrane formation is ensured all over a substrate. It is the case where it is used as a result, for example, a hydrophobic substrate, and when holding this substrate in a cup and performing washing processing, Myst of a penetrant remover which rebounds from this cup adheres on the liquid membrane of the hydrophilic property concerned, and the particle contained in this Myst is discharged by the centrifugal force of the rotating substrate besides a substrate with liquid membrane. Thereby, it can prevent that particle adheres on a direct substrate.

[0023] According to the gestalt of 1 of this invention, when said washing nozzle moves near the periphery section of said substrate, a means to control to supply the liquid by said 2nd liquid supply nozzle is provided. While being able to prevent adhesion of Myst of the cup rebound phenomenon, when a rinse is used, for example for a liquid by this, the amount of the rinse used can be reduced.

[0024] The substrate washing approach of this invention possesses the process which carries out the regurgitation of the penetrant remover on the rotating substrate, and the process which supplies a liquid and forms liquid membrane on a substrate on this substrate in the case of said washing process.

[0025] Since it is washing by breathing out a penetrant remover according to such a configuration, making the liquid membrane of a hydrophilic property form on a substrate, even if

it is the case where a hydrophobic substrate is used, for example, it can prevent that particle adheres on a direct substrate.

[0026] The spreading processing section in which the substrate processing system of this invention applies a resist on a substrate, The development section which performs a development to the substrate with which said resist was applied, and the heat treatment section which performs thermal processing to a substrate, The washing nozzle which can prepare the rotating substrate top in the direction of a path movable, and carries out the regurgitation of the penetrant remover to the rotation attaching part which holds a substrate pivotable, The conveyance device in which a substrate is conveyed between the substrate washing station which has the liquid supply nozzle which supplies a liquid on a substrate and forms liquid membrane on a substrate in the case of washing by said washing nozzle, and said spreading processing section, the development section, the heat treatment section and a substrate washing station is provided.

[0027] According to such a configuration, in a photolithography process including resist spreading processing, a development, heat treatment, etc., said substrate washing station is united with the spreading processing section, the development section, and the heat treatment section, and improvement in a throughput can be aimed at by carrying out automatic conveyance of the substrate according to a conveyance device at each processing section and a processor.

[0028]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing.

[0029] Drawing 1 – drawing 3 are drawings showing the whole spreading development system configuration concerning this invention, and drawing 1 is [a front view and drawing 3 of the top view and drawing 2] rear view.

[0030] This spreading development system 1 carries in the semi-conductor wafer W to a system from the exterior per two or more sheets, for example, 25 sheets, by the wafer cassette CR as a processed substrate. Take out from a system or The cassette station 10 for carrying in and taking out Wafer W to the wafer cassette CR, The processing station 11 which comes to carry out multistage arrangement of the various processing units of single wafer processing which performs one predetermined processing at a time to Wafer W in a spreading development process in a predetermined location, It has the configuration which connected to one the interface section 12 for delivering Wafer W between the aligners (not shown) which adjoin this processing station 11 and are formed.

[0031] At the cassette station 10, as shown in drawing 1 , the wafer cassette CR to four pieces turns two or more each wafer entrances to the location of projection 20a on the cassette installation base 20 at the processing station 11 side, for example, it is laid in the direction single tier of X, and the wafer conveyance object 21 movable in the wafer array direction (Z direction) of the wafer contained in the cassette array direction (the direction of X) and the wafer cassette CR accesses each wafer cassette CR alternatively. Furthermore, this wafer conveyance object 21 is constituted pivotable in the direction of theta, and can also access now the alignment unit (ALIM) and extention unit (EXT) which belong to the multistage unit section of 3rd group G3 by the side of the processing station 11 so that it may mention later.

[0032] At the processing station 11, as shown in drawing 1 , the main wafer conveyance device 22 of a perpendicular conveyance mold is formed in a core, all processing units cover the surroundings of it at 1 set or two or more groups, and it is arranged multistage. In this example, 5 sets is G1, G2, G3, and the multistage arrangement configuration of G4 and G5. The multistage unit of the 1st and 2nd groups G1 and G2 is juxtaposed at a system transverse-plane (it sets to drawing 1 and is this side) side. The multistage unit of 3rd group G3 adjoins the cassette station 10, and is arranged, the multistage unit of the 4th group G4 adjoins the interface section 12, and is arranged, and the multistage unit of the 5th group G5 is arranged at the regions-of-back side. In addition, the 5th group G5 is constituted movable along with the rail 25 for the maintenance of the main wafer conveyance device 22.

[0033] The main wafer conveyance device 22 has equipped the wafer transport device 46 free [rise and fall in the vertical direction (Z direction)] inside the tubed base material 49. It

connects with the revolving shaft of a motor (not shown), and with the rotation driving force of this motor, the tubed base material 49 can be rotated to the wafer transport device 46 and one centering on said revolving shaft, and, thereby, this wafer transport device 46 can rotate it freely in the direction of theta.

[0034] As shown in drawing 2 , in the 1st group G1, the washing processing unit 50 as a substrate washing station concerning two sets (COT) of the spinner mold processing units which put Wafer W on a spin chuck within Cup CP, and perform predetermined processing, for example, a resist spreading processing unit, and this invention has put on two steps sequentially from the bottom. In the 2nd group G2, two sets (DEV) of spinner mold processing units, for example, a development unit, and the same washing processing unit 50 as the 1st group G1 have put on two steps sequentially from the bottom.

[0035] Sequentially from the processing unit of an oven mold which puts Wafer W on an installation base and performs predetermined processing, for example, the bottom, as shown in drawing 3 , in 3rd group G3, a cooling unit (COL), an adhesion unit (AD), the alignment unit (ALIM), the extention unit (EXT), the reverse unit (RVS), and the PURIBE king unit (PREBAKE) have piled up. Two steps, the extention cooling unit (EXTCOL), the extention unit (EXT), the PURIBE king unit (PREBAKE), and the post baking unit (POBAKE) have also piled [the cooling unit (COL)] up the 4th group G4 sequentially from the processing unit of an oven mold, for example, the bottom.

[0036] Thus, the thermal mutual intervention between units can be lessened by arranging a cooling unit (COL) with low processing temperature, and (EXTCOL) in the lower berth, and arranging the high baking unit (PREBAKE) and post baking unit (POBAKE) of processing temperature on the upper case. However, considering as random multistage arrangement is also possible.

[0037] Although the interface section 12 has the same dimension as the processing station 11 in the depth direction, crosswise, it is built by small size. The pickup cassette CR of portability and the buffer cassette BR of a fixed mold are arranged in the forward surface part of the interface section 12 at two steps, the circumference aligner 23 is arranged in the tooth-back section, and the wafer conveyance object 24 is formed in the center section. This wafer conveyance object 24 moves to X and a Z direction, and accesses both the cassettes CR and BR and the circumference aligner 23. Furthermore, it is constituted pivotable in the direction of theta, the extention unit (EXT) belonging to the multistage unit of the 4th group G4 by the side of the processing station 11 and an adjoining aligner side carry out wafer delivery, and the wafer conveyance object 24 can also access a base (not shown) now.

[0038] The top view in which drawing 4 shows the outline structure of the above-mentioned washing processing unit 50, the sectional view which looked at drawing 5 from X in drawing 4 , and drawing 6 are the sectional views seen from Y in drawing 4 .

[0039] opening 68a for the conveyance arm of the main wafer conveyance device 22 to carry out carrying-in appearance of the wafer to the case 68 of this washing processing unit 50 is formed, and the shutter member 69 which has a breaker style is arranged at this opening 68a.

[0040] The cup CP which holds Wafer W in a unit center section so that the periphery section of Wafer W may be surrounded is arranged, and this cup CP is constituted by the elevator style 74 free [rise and fall], when delivering a wafer between the main wafer conveyance devices 22, it is arranged in a downward location, and it is arranged during the washing processing mentioned later at a rise location. It can prevent that the Myst-ized penetrant remover which was generated during washing processing diffuses towards the exterior of Cup CP by this.

[0041] In this cup CP, the spin chuck 71 which holds and rotates Wafer W is formed. This spin chuck 71 has chuck plate 71a, pivot 71b which supports this chuck plate 71a, rotation drive-motor 71c which rotates this pivot 71b, and 71d of desorption devices in which desorption of Wafer W is performed in chuck plate 71a. Moreover, support pin 71e (it sets to drawing 4 and they are six places) arrangement of is done, and this wafer W is laid in the front face of chuck plate 71a in contact with the top-most vertices of this support pin 71e. Adjustment of a rotational frequency is attained, for example, rotation drive-motor 71c has come to be able to carry out adjustable dynamically in the range of 0rpm - 5000rpm.

[0042] 71d of desorption devices of Wafer W is arranged in three peripheries of chuck plate 71a. Here, in drawing 5 , the condition of having held Wafer W is shown and 71d of left-hand side desorption devices shows the condition that 71d of right-hand side desorption devices does not hold Wafer W, in drawing 5 . The connection table 72 of one sheet which can go up and down in the rise-and-fall cylinder 79 is formed in the lower part section of chuck plate 71a, and contact fixture 72b is arranged in three corresponding to the arrangement location of 71d of desorption devices in this connection table 72 top, respectively. Wafer W is held like 71d of desorption devices of the left-hand side in drawing 5 by the elastic member which will not be illustrated if the maintenance condition of Wafer W is canceled like 71d of desorption devices by the side of drawing 5 Nakamigi and contact fixture 72b is dropped conversely when contact fixture 72b will press respectively in contact with 71d of desorption devices, if contact fixture 72b is raised in the rise-and-fall cylinder 79.
[0043] The drain 75 is formed in the inner circumference side pars basilaris ossis occipitalis of Cup CP, and the exhaust air in Cup CP and discharge of a penetrant remover or a rinse are performed. or [it being exhausted by the vacuum device which is not illustrated, for example about this exhaust air, and weakening exhaust air in the case of delivery of the wafer between the main wafer conveyance devices 22] -- or drawing in into the cup CP of particle generated by the mechanical movement in the case of delivery can be prevented by stopping.
[0044] The 2 hydraulic nozzles 36 as the 1st rinse nozzle 35 and washing nozzle which is the 1st liquid supply nozzle which stood by in the side section of Cup CP in the nozzle position in readiness 67 are being fixed to the connection member 40 in one. Distance between these 1st rinse nozzle 35 and 2 hydraulic nozzles 36 is set to 5mm - 80mm.
[0045] The pure water as a rinse is supplied to the 1st rinse nozzle 35 through a supply pipe 43 from the rinse source of supply 39, for example, it has come to be able to carry out adjustable [of the amount of supply of the rinse concerned from a nozzle 35] dynamically by the bellows pump 32 with reference to drawing 6 . The rinse amount of supply is made into for example, 0.5 l/min - 1.2 l/min with this operation gestalt.
[0046] The 2 hydraulic nozzles 36 have the buffer section 44 equipped with buffer room 44a, and the discharge part 45 which carries out the regurgitation of the penetrant remover, as shown in drawing 7 . The nitrogen gas passageway 28 for supplying nitrogen gas to the buffer room 44a concerned as inert gas and the liquid flow channel 27 for supplying pure water are formed in buffer room 44a. Passage 45a for vigor to improve the interflow object (pure water containing nitrogen gas) mixed with pure water near the outlet of the nitrogen gas passageway 28 in buffer room 44a on a wafer the regurgitation is formed in the discharge part 45.
[0047] With reference to drawing 6 , the connection member 40 which fixed the rinse nozzle 35 and the 2 hydraulic nozzles 36 of these 1st is attached in the movable nozzle maintenance arm 77 along with the guide rail 34 installed in the direction of Y. This maintenance arm 77 is connected to the belt 41 driven through a driving pulley 31 with a stepping motor 38, at the rotational frequency of a stepping motor 38, the passing speed of the maintenance arm 77 is constituted by adjustable, and, thereby, the passing speed of the 1st rinse nozzle 35 and the 2 hydraulic nozzles 36 has adjustable. This passing speed is made into 5 mm/sec - 10 mm/sec with this operation gestalt. In addition, rise and fall of the maintenance arm 77 are enabled by the elevator style which is not illustrated, and it can adjust now the height location of both the nozzles 35 and 36.
[0048] The number of rotations of the above-mentioned rotation drive-motor 71c, the travel of a bellows pump 32, and the number of rotations of a stepping motor 38 are controlled by the control system 33 integrative, can carry out adjustable [of the rinse amount of supply from the 1st rinse nozzle 35] dynamically based on the passing speed of the maintenance arm 77, and have come to be able to carry out adjustable [of the rinse amount of supply] dynamically based on the number of rotations of rotation drive-motor 71c.
[0049] The 2nd rinse nozzle 83 which is that of the 2nd liquid supply nozzle which supplies a liquid to the outside upper part of Cup CP as well as the rinse nozzle 35 of the above 1st on Wafer W is arranged. From this 2nd rinse nozzle 83, pure water is supplied as a rinse. This 2nd rinse nozzle 83 can change Z direction height and the regurgitation include angle of a rinse by

height and the direction regulatory mechanism 85.
[0050] Here, in the case of the gestalt of the same liquid as a penetrant remover, and this operation, pure water is supplied from a liquid supply nozzle. When a penetrant remover contains a drug solution, and the same drug solution is supplied from a liquid supply nozzle, it is effective in that there is no concentration change. Moreover, when searching for the effectiveness of decreasing the drug solution concentration of the affix to the cup of Myst, using pure water and a drug solution with concentration lower than a penetrant remover is also considered. Moreover, pure water is used also as a rinse after washing.
[0051] Next, a series of down stream processing in the spreading development system 1 explained above is explained.
[0052] First, at the cassette station 10, the wafer conveyance object 21 accesses the cassette CR which has held the wafer before the processing on the cassette installation base 20, picks out one wafer W from the cassette CR, and is conveyed by the alignment unit (ALIM). After alignment of Wafer W is performed in this alignment unit (ALIM), Wafer W is conveyed according to the main wafer conveyance device 22 to a reverse unit (RVS), and a rear face is turned upwards and it is made reversed so that the front face which is a field in which a device is formed in a wafer may turn down. And it is conveyed to the washing processing unit 50, and washing processing by the side of a rear face is performed. Then, again, Wafer W is conveyed to a reverse unit (RVS), it is made reversed so that a front face may turn up shortly, and it is conveyed again to the washing processing unit 50, and predetermined washing processing is performed. About washing processing of this wafer W, it mentions later. In addition, a wafer front-face side is washed previously if needed, and you may make it wash a rear-face side behind.
[0053] And next it is conveyed to an adhesion unit (AD), hydrophobing processing is performed, and, subsequently predetermined cooling processing is performed in a cooling unit (COL). Then, it is conveyed by the resist spreading processing unit (COT), and rotation spreading of a resist is performed. And heat-treatment predetermined in a PURIBE king unit (PREBAKE) is performed, cooling processing is carried out in a cooling unit (COL), and exposure processing is performed by the aligner which is not illustrated through the interface section 12 with the wafer conveyance object 24 after that. After exposure processing is completed, it is conveyed by the development unit (DEV), a development is performed, and Wafer W is returned to Cassette CR through an extension unit (EXT). In addition, heat-treatment may be performed by the post baking unit (POBAKE) after a development.
[0054] Next, it explains, referring to the flow shown in drawing 8 about the washing processing in the washing processing unit 50.
[0055] First, Wafer W receives in a spin chuck 71, it is passed, and Cup CP goes up so that the periphery section of this wafer W may be covered. Next, while starting the regurgitation of a penetrant remover and a rinse from the location of both this nozzle as the 2 hydraulic nozzle 36 and the rinse nozzle 35 move (step 1) and it is shown in drawing 9 (a) so that the 2 hydraulic nozzles 36 may be located on the core of Wafer W, migration of both nozzles is started in the direction of a path at the W round edge of wafers (step 2). Moreover, rotation of Wafer W is started to this and coincidence. In addition, even if not simultaneous with regurgitation initiation of a penetrant remover and a rinse, you may make it make rotation start before this about rotation initiation of this wafer W.
[0056] Next, as shown in drawing 9 (b), when the 2 hydraulic nozzle 36 has moved near the W round edge of wafers, the penetrant remover breathed out from these 2 hydraulic nozzles 36 rebounds by the inside of Cup CP, becomes Myst-like, and disperses towards the core side of Wafer W. However, since a rinse is supplied to Wafer W by the rinse nozzle 35 here and the liquid membrane 51 of a hydrophilic property, i.e., the water screen, is formed, Myst containing the particle adhering to Cup CP will adhere on the water screen 51. However, since Myst which there is no possibility of having a bad influence on Wafer W, and adhered on this water screen 51 since direct Myst did not necessarily adhere to a wafer side even if Myst adhered on the water screen 51 is discharged by the centrifugal force of the rotating wafer W under the cup CP with a rinse, it is satisfactory.

[0057] Then, next, if the 2 hydraulic nozzle 36 is located outside the W round edge of wafers as shown in drawing 9 (c), as both the nozzles 35 and 36 are arranged on the outside of Cup CP by stopping the regurgitation of a penetrant remover and a rinse (step 3) and it is shown in drawing 9 (d), Wafer W will be rotated at the rotational frequency of 4000rpm, the liquid on a wafer will be shaken off, and desiccation processing will be performed (step 4).
[0058] In this operation gestalt, the flow rate of a rinse, the passing speed of both the nozzles 35 and 36, and the rotational frequency of Wafer W are as being shown below, respectively, and were made into the respectively fixed value here.
Flow rate of a rinse 1.0 Passing speed of l/min both nozzles 6 Rotational frequency of a mm/sec wafer 1300 Although the rotational frequency of Wafer W was set to 1300rpm with this operation gestalt as the rpm above-mentioned was carried out, it may be smaller than this or may be large. However, since it will be in the condition that cannot form liquid membrane all over a wafer top, but many dots are scattered on a wafer side when a wafer is hydrophobicity if a wafer rotational frequency is made smaller than 300rpm, it is required to be referred to as 300 or more rpm.
[0059] As mentioned above, since it is washing by breathing out a penetrant remover according to this operation gestalt, making the liquid membrane 51 of a hydrophilic property form on a wafer, adhesion of particle can be prevented even if it is a hydrophobic wafer.
[0060] Moreover, since the rinse was supplied to the wafer core side rather than the location where the rinse nozzle 35 is arranged and a penetrant remover is supplied to the wafer core side of the 2 hydraulic nozzles 36 which move and carry out the regurgitation of the penetrant remover at a wafer Drawing 9 (b) As shown in - (c), even if it is the case where the 2 hydraulic nozzle 36 separates outside from the wafer periphery section, the rinse nozzle 35 close to the 2 hydraulic nozzle 36 always supplies a rinse to the wafer periphery section, and forms liquid membrane. Therefore, it can prevent that particle adheres to the wafer periphery section with much rebound-phenomenon Myst from Cup CP especially.
[0061] here, with reference to drawing 10 - drawing 13 , it can set like before to the washing processing only by the regurgitation of 2 fluid penetrant remover, and the washing processing at the time of supplying a rinse like this operation gestalt and forming liquid membrane -- the elimination factor (drawing 10 , 11) and augend (drawing 12 , 13) of particle on a wafer side are measured, respectively. The class of wafer experimented about a hydrophilic property and hydrophobicity. Moreover, in drawing 10 - drawing 14 , an axis of abscissa is the flow rate of the nitrogen gas in 2 hydraulic nozzles, and expresses reference condition as "N" of "Nl."
[0062] Drawing 10 shows the wafer of a hydrophilic property, and the elimination factor of particle is almost the same by the existence of rinse supply, and it is changeless for the washing engine performance about the wafer of a hydrophilic property. However, as shown in drawing 11 , in a hydrophobic wafer, it is the existence of supply of a rinse, and in 60 or more Nl/min, the difference remarkable in the elimination factor of particle arose [the flow rate of nitrogen gas] especially. From this result, as for the flow rate of nitrogen gas, it is desirable to consider as 60 Nl/min - 100 Nl/min, and when it is especially 80 Nl/min, it is understood that the elimination factor of particle is the highest.
[0063] Moreover, drawing 12 and drawing 13 show the augend of the particle on one wafer to a nitrogen quantity of gas flow, and substantial contents are the same as that of drawing 10 and drawing 11 respectively.
[0064] Next, with reference to drawing 14 , the case where adjustable [of the flow rate of a rinse, the passing speed (passing speed of =2 hydraulic nozzle) of the rinse nozzle 35, or the rotational frequency of Wafer W] is dynamically carried out in the middle of the migration on the wafer of the rinse nozzle 35 is explained.
[0065] For example, when making the flow rate of a rinse adjustable and seting constant the passing speed and the wafer rotational frequency of the rinse nozzle 35, the flow rate of the rinse supplied to the periphery section of Wafer W is made [more] than the flow rate of the rinse supplied by the wafer core. As shown in drawing 14 (a) as 1 operation gestalt, it considers as 0.5 l/min in a core, and is considering as 1.2 l/min in the periphery section. In this case, although that core differs in the peripheral velocity of Wafer W from the periphery section, the amount of supply of the rinse supplied to per unit time amount on a wafer side by changing the

flow rate of a rinse in this way can be made the same as much as possible in a core and the periphery section. in addition, you may carry out adjustable [of the amount of supply] in the middle of migration of the rinse nozzle 35 in this case in two steps, for example, may carry out until [1.2 l/min] adjustable from 0.5 l/min gradually above a three-stage.
[0066] Next, when making passing speed of the rinse nozzle 35 adjustable and seting constant the amount of supply and wafer rotational speed of a rinse, the rate of the rinse nozzle 35 in case a rinse is supplied to the periphery section of Wafer W is made smaller than the rate of the rinse nozzle 35 when being supplied by the wafer core. As shown in drawing 14 (b) as 1 operation gestalt, it considers as 7 mm/sec in a core, and is considering as 5 mm/sec in the periphery section. In this case, although that core differs in the peripheral velocity of Wafer W from the periphery section, the amount of supply of the rinse supplied to per unit time amount on a wafer side by changing the passing speed of the rinse nozzle 35 in this way can be made the same as much as possible in a core and the periphery section. in addition, you may carry out adjustable [of the passing speed] in the middle of migration of this rinse nozzle 35 in two steps, for example, may carry out until [5 mm/sec] adjustable from 7 mm/sec gradually above a three-stage.
[0067] Next, when making the rotational frequency of Wafer W adjustable and seting constant the passing speed of the rinse nozzle 35, and the amount of supply of a rinse, a wafer rotational frequency in case a rinse is supplied to the W round edge of wafers is made smaller than a rotational frequency in case a rinse is supplied by the wafer core. As shown in drawing 14 (c) as 1 operation gestalt, it is referred to as 1500rpm in a core, and is referred to as 1000rpm in the periphery section. In this case, the amount of supply of the rinse supplied to per unit time amount on a wafer side can be made the same as much as possible in a core and the periphery section. in addition, you may carry out adjustable [of the rotational frequency] in the middle of migration of this rinse nozzle 35 in two steps, for example, may carry out until [1000rpm] adjustable from 1500rpm gradually above a three-stage.
[0068] As mentioned above, the washing engine performance is made to homogeneity about the whole surface of a wafer by carrying out adjustable [of the flow rate of a rinse, the passing speed of the rinse nozzle 35, or the rotational frequency of Wafer W] in the middle of the migration on the wafer of the rinse nozzle 35 dynamically.
[0069] Next, with reference to drawing 15 - drawing 18 , the washing processing at the time of using the 2nd rinse nozzle 83 is explained.
[0070] In drawing 15 , breathing out a penetrant remover not using the 1st rinse nozzle 35 but moving only the 2 hydraulic nozzle 36 in the direction of a path of Wafer W from a core to the periphery section, a rinse is supplied to the core of a position W, for example, a wafer, by the 2nd rinse nozzle 83, and liquid membrane 51 is formed. It can prevent that cup rebound-phenomenon Myst generated by this when the 2 hydraulic nozzle 36 moves to the wafer periphery section adheres to Wafer W directly.
[0071] The 1st rinse nozzle 35 is not used in drawing 16 . First, although it is made to move to the periphery section from a core as shown in drawing 16 (a), breathing out a penetrant remover from the 2 hydraulic nozzles 36 to a wafer core, at this time, the rinse is not breathed out from the 2nd rinse nozzle 83. This is because it is rare for a penetrant remover to rebound upon Cup CP when the 2 hydraulic nozzle 36 starts the regurgitation of a penetrant remover from the center position of Wafer W as shown in drawing 16 (a). And while being able to prevent adhesion of rebound-phenomenon Myst by supplying a rinse and forming liquid membrane 51 at this time next since Myst of the cup rebound phenomenon increases when the 2 hydraulic nozzle 36 moves to near the periphery section of Wafer W as shown in drawing 16 (b), compared with the case in drawing 15 , the amount of the rinse used is reducible.
[0072] The 1st rinse nozzle 35 is not used in drawing 17 (a) and drawing 17 (b). While making it move to the periphery section from a core as first shown in drawing 17 (a), breathing out a penetrant remover from the 2 hydraulic nozzle 36, liquid membrane 51 is formed by rinse supply. And as shown in drawing 17 (b), when the 2 hydraulic nozzle 36 comes to the periphery section, according to the location where a penetrant remover is breathed out, adhesion of Myst in the wafer periphery section can be more certainly prevented by carrying out the supply location of a

rinse near the wafer periphery section by changing the regurgitation include angle of the rinse of the 2nd rinse nozzle 83.
[0073] Drawing 18 is using both 1st and 2nd rinse nozzle 36 and 83. in this case, the 2 hydraulic nozzle 36 and the 1st rinse nozzle 35 — the periphery section from a core — while moving — a penetrant remover and a rinse — discharge — in addition to this, the rinse is further supplied also from the 2nd rinse nozzle 83. Liquid membrane 51 can be certainly formed all over wafer W by this, and adhesion of Myst can be prevented certainly.
[0074] Drawing 19 and drawing 20 are the top views and front views showing the whole washing processing-system configuration concerning 1 operation gestalt. In addition, in drawing 19 and drawing 20 , the sign same about the same thing as the component in drawing 1 and drawing 2 shall be attached, and the explanation is omitted.
[0075] The main wafer conveyance device 22 is arranged in four sets and a center section for the washing processing unit 50 for washing of Wafer W at the transverse-plane side of the processing station 11. This main wafer conveyance device 22 is adjoined, and the reverse unit (RVS) 90 which reverses a heat treatment unit (H.P.) and the cooling processing unit (COL) 91 required for the desiccation after washing, the transition unit (TRS) which delivers Wafer W between the cassette station 10 and the processing station 11, and the front flesh side of Wafer W is arranged. moreover — processing — a station — 11 — a tooth back — a side — **** — washing — a processing system — two — the whole — actuation - control — carrying out — a sake — electrical — a unit — (— EB —) — 93 — machine control — a unit — (— MB —) — 94 — washing — processing — a unit — 50 — using it — having — predetermined — a penetrant remover — storing — a drug solution — storage — a unit (CTB) — 92 — arranging — having — **** . Furthermore, the fan filter unit (FFU) 95 for carrying out the downflow of the air purer than the head-lining section is arranged in the processing station 11.
[0076] Such a washing processing system 2 can be used as washing dedicated system in processes other than the above-mentioned spreading development system 1. For example, as processes other than a spreading development process, specific gas or several sorts of compound gas is supplied on Wafer W. Although there is an etching process which only required thickness etches, the whole surface or the particular part of a thin film formed on the CVD process and wafer W front face in which a desired thin film is made to form by the chemical reaction in a wafer W front face It can use as an exclusive processing system for washing the wafer polluted during processing of these CVD(s) process or an etching process.
[0077] In addition, with this operation gestalt, although the washing processing system 2 was explained as a system of a simple substance, the CVD system used at the above-mentioned CVD process, the etching system used at an etching process, and the washing processing system 2 can be connected through an interface device etc., and it can be used as compound equipment made in-line.
[0078] This invention is not limited to the operation gestalt explained above, and various deformation is possible for it.
[0079] For example, in washing down stream processing shown in drawing 9 (a) and (b), when the 2 hydraulic nozzle 36 starts the regurgitation of a penetrant remover from the center position of Wafer W Since cup rebound-phenomenon Myst increases when the 2 hydraulic nozzle 36 comes to the wafer periphery section as it does not carry out, for example, is shown in drawing 9 (b), you may make it the regurgitation of the rinse from the rinse nozzle 35 supply a rinse like the case where it is shown in drawing 16 (a) and (b). When the 2 hydraulic nozzle 36 starts the regurgitation of a penetrant remover from the center position of Wafer W, that a penetrant remover rebounds upon Cup CP has little this, and when the 2 hydraulic nozzle 36 moves to near the periphery section of Wafer W, it is because it will be in the condition of being easy to generate Myst of the rebound phenomenon. Thereby, the amount of the rinse used is reducible.
[0080] Moreover, in drawing 15 , drawing 16 (a), (b), and drawing 18 , although it was made to supply a wafer core, if the rinses from the rinse nozzle 83 are a penetrant remover by the 2 hydraulic nozzle 36, and the supply location in which it does not interfere, they will not be restricted to a wafer core.
[0081] Furthermore, with the above-mentioned operation gestalt, although the semi-conductor

wafer was used as a substrate, this invention is applicable also about the glass substrate used not only for this but for a liquid crystal display etc.

[0082]

[Effect of the Invention] As explained above, according to this invention, it cannot be concerned with the hydrophilic property of a substrate, or hydrophobicity, but adhesion of the particle resulting from Myst generating can be prevented, and the washing engine performance can be raised.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the substrate washing station and the substrate washing approach of washing a semi-conductor wafer substrate in manufacture of a semiconductor device.

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PRIOR ART

[Description of the Prior Art] It is necessary to maintain highly the cleanliness of the front rear face of a semi-conductor wafer (henceforth a "wafer"), especially the front face of a wafer in which a semiconductor device is formed, and, for this reason, washing on the rear face of front of a wafer is performed before and behind various manufacture processes in manufacture of a semiconductor device.
[0003] In a photolithography process, washing on the rear face of front of a wafer is indispensable especially. For example, holding a wafer in the cup for preventing scattering of a penetrant remover, or collecting and discarding the penetrant remover after use, rotating a wafer within this cup, and supplying a penetrant remover to that wafer top face Scrub washing which removes contaminants, such as particle adhering to a wafer top face, by carrying out both-way migration of the rotating brush between the core of a wafer and the periphery section, contacting a wafer top face is performed.
[0004] Moreover, he carries out jet injection of the interflow object (two fluids) which mixed ultrasonic-cleaning water, and inert gas and pure water for example, not only washing with a rotation brush but on the wafer by the nozzle, and is trying to remove more detailed particle in this scrub washing in recent years. (For example, patent reference 1 reference.) .
[0005]
[Patent reference 1] JP,10-156229,A (drawing 1 etc.).

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, it cannot be concerned with the hydrophilic property of a substrate, or hydrophobicity, but adhesion of the particle resulting from Myst generating can be prevented, and the washing engine performance can be raised.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, when carrying out jet injection of the penetrant removers, such as ultrasonic-cleaning water and two fluids, and washing a wafer, and the wash water of jet injection becomes Myst-like and rebounds by the internal surface of a cup which held especially the wafer, the particle which sprinkled the particle adhering to the internal surface of the cup concerned etc., and was sprinkled in this way adheres to a wafer. That is, originally, although the cup has the function in which prevent that a penetrant remover disperses around, or a penetrant remover flows caudad and falls along with the internal surface of a cup during wafer washing, since there are many flow rates and these wash water has strong injection vigor when wash water, such as ultrasonic-cleaning water and two fluids, is used, it will rebound by the cup internal surface.
[0007] The contact angle over the wafer front face of the penetrant remover which contains the particle adhering to a wafer when the wafer which is a processing object in this case is a wafer of a hydrophilic property is small, and since it will be in the condition of the penetrant remover concerned flowing from a wafer with particle, and being easy to fall, it is satisfactory. However, since ******** is large and wettability is bad when the wafer which is a processing object is a hydrophobic wafer, in spite of being in the middle of the regurgitation of a penetrant remover, a wafer side is exposed, direct Myst-like particle adheres to a wafer side, and this cannot be removed.
[0008] In view of the above situations, the purpose of this invention is not concerned with a hydrophilic property or one of hydrophobic substrates, but is to offer the substrate washing station which can prevent adhesion of the particle to the substrate top concerned, and the substrate washing approach.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the substrate washing station concerning the 1st viewpoint of this invention possesses the washing nozzle which can prepare the substrate top which rotates with the rotation attaching part which holds a substrate pivotable in the direction of a path movable, and carries out the regurgitation of the penetrant remover, and the liquid supply nozzle which supplies a liquid on a substrate in the case of washing by said washing nozzle, and forms liquid membrane on a substrate.
[0010] Since it is washing by breathing out a penetrant remover according to such a configuration, making the liquid membrane of a hydrophilic property form to a substrate on a substrate for example, in being the case where a hydrophobic substrate is used, holding this substrate in a cup and performing washing processing Myst of a penetrant remover which rebounds from this cup adheres on the liquid membrane of the hydrophilic property concerned, and the particle contained in this Myst is discharged by the centrifugal force of the rotating substrate besides a substrate with liquid membrane. Thereby, it can prevent that particle adheres on a direct substrate.
[0011] Here, it is the semantics of forming the film of a hydrophilic property for a substrate front face, saying "form the liquid membrane of a hydrophilic property." That is, it means that a hydrophobic substrate front face becomes a hydrophilic property by forming liquid membrane on a substrate.
[0012] According to the gestalt of 1 of this invention, the liquid supplied by said liquid supply nozzle on a substrate is supplied to the center-of-rotation side of a substrate from said washing nozzle.
[0013] According to the gestalt of 1 of this invention, when said washing nozzle moves near the periphery section of a substrate, a means to control to start supply of the liquid by said liquid supply nozzle is provided further.
[0014] According to the gestalt of 1 of this invention, said substrate is a hydrophobic substrate.
[0015] According to the gestalt of 1 of this invention, the liquid supplied by said liquid supply nozzle on a substrate is a rinse.
[0016] According to the gestalt of 1 of this invention, the rinse supplied by said liquid supply nozzle on a substrate is pure water.
[0017] According to the gestalt of 1 of this invention, said penetrant remover is the interflow object of inert gas and a liquid. Since the discharge pressure and pure water of this gas are made to perform washing processing of a substrate, using pure water as a liquid, using nitrogen gas as this inert gas, the amount of scattering of the penetrant remover by the washing nozzle serves as a situation which Myst tends to generate. In this case, the Myst antisticking effectiveness by liquid membrane formation of this invention is large. Here, the flow rate of the inert gas of a penetrant remover is made into 10 Nl/min - 200 Nl/min. It is 80 Nl/min more preferably.
[0018] According to the gestalt of 1 of this invention, said liquid supply nozzle is arranged movable in one with said washing nozzle which moves. Moreover, said liquid supply nozzle is arranged in this case at a substrate core side to said washing nozzle which moves, and, as for the distance of said washing nozzle and a liquid supply nozzle, it is still more desirable to be

referred to as 5mm - 80mm. Thus, even if it is the case where the washing nozzle separates from the substrate periphery section to the outside, for example since permanence was supplied to the substrate core side rather than the location where a liquid supply nozzle is arranged to the substrate core side of the washing nozzle which moves and carries out the regurgitation of the penetrant remover, and a penetrant remover is supplied to a substrate, a liquid supply nozzle always supplies a liquid to the substrate periphery section, and liquid membrane is formed. Therefore, it can prevent that particle adheres to the substrate periphery section with much rebound-phenomenon Myst from a cup especially. Moreover, the same effectiveness is acquired also when a rinse is used as a liquid.

[0019] According to the gestalt of 1 of this invention, a means to control to make [more] the flow rate of the liquid supplied to the periphery section of said substrate than the flow rate of the liquid supplied by the substrate core is provided further. Or a means to control to make the rate of a liquid supply nozzle in case said liquid is supplied to the periphery section of said substrate smaller than the rate of the liquid supply nozzle when being supplied by the substrate core is provided further. Although the core differs in the rotational speed of a substrate from the periphery section, as a result of being able to make the same the amount of supply of the liquid supplied to per unit time amount on a substrate side as much as possible in a core and the periphery section, the washing engine performance can be made into homogeneity all over a substrate by changing the flow rate of a liquid, or the passing speed of a liquid supply nozzle in this way. Here, the flow rate of a liquid is made into 0.5 l/min - 1.2 l/min, and, as for the rate of a liquid supply nozzle, it is desirable to consider as 5 mm/sec - 30 mm/sec.

[0020] According to the gestalt of 1 of this invention, a means to control to make the rotational frequency of a substrate in case said liquid is supplied to the periphery section of said substrate smaller than a rotational frequency in case said liquid is supplied by the substrate core is provided further. Thus, since it is carrying out adjustable [of the rotational speed of a substrate] corresponding to the supply location of a liquid, as a result of being able to make the same the amount of supply of the liquid supplied to per unit time amount on a substrate side as much as possible in a core and the periphery section, the washing engine performance can be made into homogeneity all over a substrate. Here, as for the rotational frequency of a substrate, it is desirable to be referred to as 300rpm - 5000rpm.

[0021] The rotation attaching part to which the substrate washing station concerning the 2nd viewpoint of this invention holds a substrate pivotable, The washing nozzle which can prepare the rotating substrate top in the direction of a path movable, and carries out the regurgitation of the penetrant remover, The 1st liquid supply nozzle which is arranged movable in one with said washing nozzle which moves, supplies a liquid on a substrate in the case of washing by said washing nozzle, and forms liquid membrane on a substrate, The 2nd liquid supply nozzle which supplies a liquid to the position of said substrate and forms liquid membrane on a substrate with said 1st liquid supply nozzle in the case of washing by said washing nozzle is provided.

[0022] A penetrant remover is breathed out moving the liquid supply nozzle of ** a 1st in one in a washing nozzle according to such a configuration, and making the liquid membrane of a hydrophilic property form on a substrate, liquid membrane formation near the washing nozzle is ensured especially, a liquid is further supplied to for example, a substrate core by the liquid supply nozzle of ** a 2nd, and liquid membrane formation is ensured all over a substrate. It is the case where it is used as a result, for example, a hydrophobic substrate, and when holding this substrate in a cup and performing washing processing, Myst of a penetrant remover which rebounds from this cup adheres on the liquid membrane of the hydrophilic property concerned, and the particle contained in this Myst is discharged by the centrifugal force of the rotating substrate besides a substrate with liquid membrane. Thereby, it can prevent that particle adheres on a direct substrate.

[0023] According to the gestalt of 1 of this invention, when said washing nozzle moves near the periphery section of said substrate, a means to control to supply the liquid by said 2nd liquid supply nozzle is provided. While being able to prevent adhesion of Myst of the cup rebound phenomenon, when a rinse is used, for example for a liquid by this, the amount of the rinse used can be reduced.

[0024] The substrate washing approach of this invention possesses the process which carries out the regurgitation of the penetrant remover on the rotating substrate, and the process which supplies a liquid and forms liquid membrane on a substrate on this substrate in the case of said washing process.
[0025] Since it is washing by breathing out a penetrant remover according to such a configuration, making the liquid membrane of a hydrophilic property form on a substrate, even if it is the case where a hydrophobic substrate is used, for example, it can prevent that particle adheres on a direct substrate.
[0026] The spreading processing section in which the substrate processing system of this invention applies a resist on a substrate, The development section which performs a development to the substrate with which said resist was applied, and the heat treatment section which performs thermal processing to a substrate, The washing nozzle which can prepare the rotating substrate top in the direction of a path movable, and carries out the regurgitation of the penetrant remover to the rotation attaching part which holds a substrate pivotable, The conveyance device in which a substrate is conveyed between the substrate washing station which has the liquid supply nozzle which supplies a liquid on a substrate and forms liquid membrane on a substrate in the case of washing by said washing nozzle, and said spreading processing section, the development section, the heat treatment section and a substrate washing station is provided.
[0027] According to such a configuration, in a photolithography process including resist spreading processing, a development, heat treatment, etc., said substrate washing station is united with the spreading processing section, the development section, and the heat treatment section, and improvement in a throughput can be aimed at by carrying out automatic conveyance of the substrate according to a conveyance device at each processing section and a processor.
[0028]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing.
[0029] Drawing 1 – drawing 3 are drawings showing the whole spreading development system configuration concerning this invention, and drawing 1 is [a front view and drawing 3 of the top view and drawing 2] rear view.
[0030] This spreading development system 1 carries in the semi-conductor wafer W to a system from the exterior per two or more sheets, for example, 25 sheets, by the wafer cassette CR as a processed substrate. Take out from a system or The cassette station 10 for carrying in and taking out Wafer W to the wafer cassette CR, The processing station 11 which comes to carry out multistage arrangement of the various processing units of single wafer processing which performs one predetermined processing at a time to Wafer W in a spreading development process in a predetermined location, It has the configuration which connected to one the interface section 12 for delivering Wafer W between the aligners (not shown) which adjoin this processing station 11 and are formed.
[0031] At the cassette station 10, as shown in drawing 1 , the wafer cassette CR to four pieces turns two or more each wafer entrances to the location of projection 20a on the cassette installation base 20 at the processing station 11 side, for example, it is laid in the direction single tier of X, and the wafer conveyance object 21 movable in the wafer array direction (Z direction) of the wafer contained in the cassette array direction (the direction of X) and the wafer cassette CR accesses each wafer cassette CR alternatively. Furthermore, this wafer conveyance object 21 is constituted pivotable in the direction of theta, and can also access now the alignment unit (ALIM) and extention unit (EXT) which belong to the multistage unit section of 3rd group G3 by the side of the processing station 11 so that it may mention later.
[0032] At the processing station 11, as shown in drawing 1 , the main wafer conveyance device 22 of a perpendicular conveyance mold is formed in a core, all processing units cover the surroundings of it at 1 set or two or more groups, and it is arranged multistage. In this example, 5 sets is G1, G2, G3, and the multistage arrangement configuration of G4 and G5. The multistage unit of the 1st and 2nd groups G1 and G2 is juxtaposed at a system transverse-plane (it sets to drawing 1 and is this side) side. The multistage unit of 3rd group G3 adjoins the cassette station

10, and is arranged, the multistage unit of the 4th group G4 adjoins the interface section 12, and is arranged, and the multistage unit of the 5th group G5 is arranged at the regions-of-back side. In addition, the 5th group G5 is constituted movable along with the rail 25 for the maintenance of the main wafer conveyance device 22.
[0033] The main wafer conveyance device 22 has equipped the wafer transport device 46 free [rise and fall in the vertical direction (Z direction)] inside the tubed base material 49. It connects with the revolving shaft of a motor (not shown), and with the rotation driving force of this motor, the tubed base material 49 can be rotated to the wafer transport device 46 and one centering on said revolving shaft, and, thereby, this wafer transport device 46 can rotate it freely in the direction of theta.
[0034] As shown in drawing 2 , in the 1st group G1, the washing processing unit 50 as a substrate washing station concerning two sets (COT) of the spinner mold processing units which put Wafer W on a spin chuck within Cup CP, and perform predetermined processing, for example, a resist spreading processing unit, and this invention has put on two steps sequentially from the bottom. In the 2nd group G2, two sets (DEV) of spinner mold processing units, for example, a development unit, and the same washing processing unit 50 as the 1st group G1 have put on two steps sequentially from the bottom.
[0035] Sequentially from the processing unit of an oven mold which puts Wafer W on an installation base and performs predetermined processing, for example, the bottom, as shown in drawing 3 , in 3rd group G3, a cooling unit (COL), an adhesion unit (AD), the alignment unit (ALIM), the extention unit (EXT), the reverse unit (RVS), and the PURIBE king unit (PREBAKE) have piled up. Two steps, the extention cooling unit (EXTCOL), the extention unit (EXT), the PURIBE king unit (PREBAKE), and the post baking unit (POBAKE) have also piled [the cooling unit (COL)] up the 4th group G4 sequentially from the processing unit of an oven mold, for example, the bottom.
[0036] Thus, the thermal mutual intervention between units can be lessened by arranging a cooling unit (COL) with low processing temperature, and (EXTCOL) in the lower berth, and arranging the high baking unit (PREBAKE) and post baking unit (POBAKE) of processing temperature on the upper case. However, considering as random multistage arrangement is also possible.
[0037] Although the interface section 12 has the same dimension as the processing station 11 in the depth direction, crosswise, it is built by small size. The pickup cassette CR of portability and the buffer cassette BR of a fixed mold are arranged in the forward surface part of the interface section 12 at two steps, the circumference aligner 23 is arranged in the tooth-back section, and the wafer conveyance object 24 is formed in the center section. This wafer conveyance object 24 moves to X and a Z direction, and accesses both the cassettes CR and BR and the circumference aligner 23. Furthermore, it is constituted pivotable in the direction of theta, the extention unit (EXT) belonging to the multistage unit of the 4th group G4 by the side of the processing station 11 and an adjoining aligner side carry out wafer delivery, and the wafer conveyance object 24 can also access a base (not shown) now.
[0038] The top view in which drawing 4 shows the outline structure of the above-mentioned washing processing unit 50, the sectional view which looked at drawing 5 from X in drawing 4 , and drawing 6 are the sectional views seen from Y in drawing 4 .
[0039] opening 68a for the conveyance arm of the main wafer conveyance device 22 to carry out carrying-in appearance of the wafer to the case 68 of this washing processing unit 50 is formed, and the shutter member 69 which has a breaker style is arranged at this opening 68a.
[0040] The cup CP which holds Wafer W in a unit center section so that the periphery section of Wafer W may be surrounded is arranged, and this cup CP is constituted by the elevator style 74 free [rise and fall], when delivering a wafer between the main wafer conveyance devices 22, it is arranged in a downward location, and it is arranged during the washing processing mentioned later at a rise location. It can prevent that the Myst-ized penetrant remover which was generated during washing processing diffuses towards the exterior of Cup CP by this.
[0041] In this cup CP, the spin chuck 71 which holds and rotates Wafer W is formed. This spin chuck 71 has chuck plate 71a, pivot 71b which supports this chuck plate 71a, rotation drive-

motor 71c which rotates this pivot 71b, and 71d of desorption devices in which desorption of Wafer W is performed in chuck plate 71a. Moreover, support pin 71e (it sets to drawing 4 and they are six places) arrangement of is done, and this wafer W is laid in the front face of chuck plate 71a in contact with the top-most vertices of this support pin 71e. Adjustment of a rotational frequency is attained, for example, rotation drive-motor 71c has come to be able to carry out adjustable dynamically in the range of 0rpm - 5000rpm.

[0042] 71d of desorption devices of Wafer W is arranged in three peripheries of chuck plate 71a. Here, in drawing 5 , the condition of having held Wafer W is shown and 71d of left-hand side desorption devices shows the condition that 71d of right-hand side desorption devices does not hold Wafer W, in drawing 5 . The connection table 72 of one sheet which can go up and down in the rise-and-fall cylinder 79 is formed in the lower part section of chuck plate 71a, and contact fixture 72b is arranged in three corresponding to the arrangement location of 71d of desorption devices in this connection table 72 top, respectively. Wafer W is held like 71d of desorption devices of the left-hand side in drawing 5 by the elastic member which will not be illustrated if the maintenance condition of Wafer W is canceled like 71d of desorption devices by the side of drawing 5 Nakamigi and contact fixture 72b is dropped conversely when contact fixture 72b will press respectively in contact with 71d of desorption devices, if contact fixture 72b is raised in the rise-and-fall cylinder 79.

[0043] The drain 75 is formed in the inner circumference side pars basilaris ossis occipitalis of Cup CP, and the exhaust air in Cup CP and discharge of a penetrant remover or a rinse are performed. or [it being exhausted by the vacuum device which is not illustrated, for example about this exhaust air, and weakening exhaust air in the case of delivery of the wafer between the main wafer conveyance devices 22] -- or drawing in into the cup CP of particle generated by the mechanical movement in the case of delivery can be prevented by stopping.

[0044] The 2 hydraulic nozzles 36 as the 1st rinse nozzle 35 and washing nozzle which is the 1st liquid supply nozzle which stood by in the side section of Cup CP in the nozzle position in readiness 67 are being fixed to the connection member 40 in one. Distance between these 1st rinse nozzle 35 and 2 hydraulic nozzles 36 is set to 5mm - 80mm.

[0045] The pure water as a rinse is supplied to the 1st rinse nozzle 35 through a supply pipe 43 from the rinse source of supply 39, for example, it has come to be able to carry out adjustable [of the amount of supply of the rinse concerned from a nozzle 35] dynamically by the bellows pump 32 with reference to drawing 6 . The rinse amount of supply is made into for example, 0.5 l/min - 1.2 l/min with this operation gestalt.

[0046] The 2 hydraulic nozzles 36 have the buffer section 44 equipped with buffer room 44a, and the discharge part 45 which carries out the regurgitation of the penetrant remover, as shown in drawing 7 . The nitrogen gas passageway 28 for supplying nitrogen gas to the buffer room 44a concerned as inert gas and the liquid flow channel 27 for supplying pure water are formed in buffer room 44a. Passage 45a for vigor to improve the interflow object (pure water containing nitrogen gas) mixed with pure water near the outlet of the nitrogen gas passageway 28 in buffer room 44a on a wafer the regurgitation is formed in the discharge part 45.

[0047] With reference to drawing 6 , the connection member 40 which fixed the rinse nozzle 35 and the 2 hydraulic nozzles 36 of these 1st is attached in the movable nozzle maintenance arm 77 along with the guide rail 34 installed in the direction of Y. This maintenance arm 77 is connected to the belt 41 driven through a driving pulley 31 with a stepping motor 38, at the rotational frequency of a stepping motor 38, the passing speed of the maintenance arm 77 is constituted by adjustable, and, thereby, the passing speed of the 1st rinse nozzle 35 and the 2 hydraulic nozzles 36 has adjustable. This passing speed is made into 5 mm/sec - 10 mm/sec with this operation gestalt. In addition, rise and fall of the maintenance arm 77 are enabled by the elevator style which is not illustrated, and it can adjust now the height location of both the nozzles 35 and 36.

[0048] The number of rotations of the above-mentioned rotation drive-motor 71c, the travel of a bellows pump 32, and the number of rotations of a stepping motor 38 are controlled by the control system 33 integrative, can carry out adjustable [of the rinse amount of supply from the 1st rinse nozzle 35] dynamically based on the passing speed of the maintenance arm 77, and

have come to be able to carry out adjustable [of the rinse amount of supply] dynamically based on the number of rotations of rotation drive-motor 71c.
[0049] The 2nd rinse nozzle 83 which is that of the 2nd liquid supply nozzle which supplies a liquid to the outside upper part of Cup CP as well as the rinse nozzle 35 of the above 1st on Wafer W is arranged. From this 2nd rinse nozzle 83, pure water is supplied as a rinse. This 2nd rinse nozzle 83 can change Z direction height and the regurgitation include angle of a rinse by height and the direction regulatory mechanism 85.
[0050] Here, in the case of the gestalt of the same liquid as a penetrant remover, and this operation, pure water is supplied from a liquid supply nozzle. When a penetrant remover contains a drug solution, and the same drug solution is supplied from a liquid supply nozzle, it is effective in that there is no concentration change. Moreover, when searching for the effectiveness of decreasing the drug solution concentration of the affix to the cup of Myst, using pure water and a drug solution with concentration lower than a penetrant remover is also considered. Moreover, pure water is used also as a rinse after washing.
[0051] Next, a series of down stream processing in the spreading development system 1 explained above is explained.
[0052] First, at the cassette station 10, the wafer conveyance object 21 accesses the cassette CR which has held the wafer before the processing on the cassette installation base 20, picks out one wafer W from the cassette CR, and is conveyed by the alignment unit (ALIM). After alignment of Wafer W is performed in this alignment unit (ALIM), Wafer W is conveyed according to the main wafer conveyance device 22 to a reverse unit (RVS), and a rear face is turned upwards and it is made reversed so that the front face which is a field in which a device is formed in a wafer may turn down. And it is conveyed to the washing processing unit 50, and washing processing by the side of a rear face is performed. Then, again, Wafer W is conveyed to a reverse unit (RVS), it is made reversed so that a front face may turn up shortly, and it is conveyed again to the washing processing unit 50, and predetermined washing processing is performed. About washing processing of this wafer W, it mentions later. In addition, a wafer front-face side is washed previously if needed, and you may make it wash a rear-face side behind.
[0053] And next it is conveyed to an adhesion unit (AD), hydrophobing processing is performed, and, subsequently predetermined cooling processing is performed in a cooling unit (COL). Then, it is conveyed by the resist spreading processing unit (COT), and rotation spreading of a resist is performed. And heat-treatment predetermined in a PURIBE king unit (PREBAKE) is performed, cooling processing is carried out in a cooling unit (COL), and exposure processing is performed by the aligner which is not illustrated through the interface section 12 with the wafer conveyance object 24 after that. After exposure processing is completed, it is conveyed by the development unit (DEV), a development is performed, and Wafer W is returned to Cassette CR through an extension unit (EXT). In addition, heat-treatment may be performed by the post baking unit (POBAKE) after a development.
[0054] Next, it explains, referring to the flow shown in drawing 8 about the washing processing in the washing processing unit 50.
[0055] First, Wafer W receives in a spin chuck 71, it is passed, and Cup CP goes up so that the periphery section of this wafer W may be covered. Next, while starting the regurgitation of a penetrant remover and a rinse from the location of both this nozzle as the 2 hydraulic nozzle 36 and the rinse nozzle 35 move (step 1) and it is shown in drawing 9 (a) so that the 2 hydraulic nozzles 36 may be located on the core of Wafer W, migration of both nozzles is started in the direction of a path at the W round edge of wafers (step 2). Moreover, rotation of Wafer W is started to this and coincidence. In addition, even if not simultaneous with regurgitation initiation of a penetrant remover and a rinse, you may make it make rotation start before this about rotation initiation of this wafer W.
[0056] Next, as shown in drawing 9 (b), when the 2 hydraulic nozzle 36 has moved near the W round edge of wafers, the penetrant remover breathed out from these 2 hydraulic nozzles 36 rebounds by the inside of Cup CP, becomes Myst-like, and disperses towards the core side of Wafer W. However, since a rinse is supplied to Wafer W by the rinse nozzle 35 here and the liquid

membrane 51 of a hydrophilic property, i.e., the water screen, is formed, Myst containing the particle adhering to Cup CP will adhere on the water screen 51. However, since Myst which there is no possibility of having a bad influence on Wafer W, and adhered on this water screen 51 since direct Myst did not necessarily adhere to a wafer side even if Myst adhered on the water screen 51 is discharged by the centrifugal force of the rotating wafer W under the cup CP with a rinse, it is satisfactory.

[0057] Then, next, if the 2 hydraulic nozzle 36 is located outside the W round edge of wafers as shown in drawing 9 (c), as both the nozzles 35 and 36 are arranged on the outside of Cup CP by stopping the regurgitation of a penetrant remover and a rinse (step 3) and it is shown in drawing 9 (d), Wafer W will be rotated at the rotational frequency of 4000rpm, the liquid on a wafer will be shaken off, and desiccation processing will be performed (step 4).

[0058] In this operation gestalt, the flow rate of a rinse, the passing speed of both the nozzles 35 and 36, and the rotational frequency of Wafer W are as being shown below, respectively, and were made into the respectively fixed value here.

Flow rate of a rinse 1.0 Passing speed of l/min both nozzles 6 Rotational frequency of a mm/sec wafer 1300 Although the rotational frequency of Wafer W was set to 1300rpm with this operation gestalt as the rpm above-mentioned was carried out, it may be smaller than this or may be large. However, since it will be in the condition that cannot form liquid membrane all over a wafer top, but many dots are scattered on a wafer side when a wafer is hydrophobicity if a wafer rotational frequency is made smaller than 300rpm, it is required to be referred to as 300 or more rpm.

[0059] As mentioned above, since it is washing by breathing out a penetrant remover according to this operation gestalt, making the liquid membrane 51 of a hydrophilic property form on a wafer, adhesion of particle can be prevented even if it is a hydrophobic wafer.

[0060] Moreover, since the rinse was supplied to the wafer core side rather than the location where the rinse nozzle 35 is arranged and a penetrant remover is supplied to the wafer core side of the 2 hydraulic nozzles 36 which move and carry out the regurgitation of the penetrant remover at a wafer Drawing 9 (b) As shown in - (c), even if it is the case where the 2 hydraulic nozzle 36 separates outside from the wafer periphery section, the rinse nozzle 35 close to the 2 hydraulic nozzle 36 always supplies a rinse to the wafer periphery section, and forms liquid membrane. Therefore, it can prevent that particle adheres to the wafer periphery section with much rebound-phenomenon Myst from Cup CP especially.

[0061] here, with reference to drawing 10 - drawing 13 , it can set like before to the washing processing only by the regurgitation of 2 fluid penetrant remover, and the washing processing at the time of supplying a rinse like this operation gestalt and forming liquid membrane -- the elimination factor (drawing 10 , 11) and augend (drawing 12 , 13) of particle on a wafer side are measured, respectively. The class of wafer experimented about a hydrophilic property and hydrophobicity. Moreover, in drawing 10 - drawing 14 , an axis of abscissa is the flow rate of the nitrogen gas in 2 hydraulic nozzles, and expresses reference condition as "N" of "Nl."

[0062] Drawing 10 shows the wafer of a hydrophilic property, and the elimination factor of particle is almost the same by the existence of rinse supply, and it is changeless for the washing engine performance about the wafer of a hydrophilic property. However, as shown in drawing 11 , in a hydrophobic wafer, it is the existence of supply of a rinse, and in 60 or more Nl/min, the difference remarkable in the elimination factor of particle arose [the flow rate of nitrogen gas] especially. From this result, as for the flow rate of nitrogen gas, it is desirable to consider as 60 Nl/min - 100 Nl/min, and when it is especially 80 Nl/min, it is understood that the elimination factor of particle is the highest.

[0063] Moreover, drawing 12 and drawing 13 show the augend of the particle on one wafer to a nitrogen quantity of gas flow, and substantial contents are the same as that of drawing 10 and drawing 11 respectively.

[0064] Next, with reference to drawing 14 , the case where adjustable [of the flow rate of a rinse, the passing speed (passing speed of =2 hydraulic nozzle) of the rinse nozzle 35, or the rotational frequency of Wafer W] is dynamically carried out in the middle of the migration on the wafer of the rinse nozzle 35 is explained.

[0065] For example, when making the flow rate of a rinse adjustable and seting constant the

passing speed and the wafer rotational frequency of the rinse nozzle 35, the flow rate of the rinse supplied to the periphery section of Wafer W is made [more] than the flow rate of the rinse supplied by the wafer core. As shown in drawing 14 (a) as 1 operation gestalt, it considers as 0.5 l/min in a core, and is considering as 1.2 l/min in the periphery section. In this case, although that core differs in the peripheral velocity of Wafer W from the periphery section, the amount of supply of the rinse supplied to per unit time amount on a wafer side by changing the flow rate of a rinse in this way can be made the same as much as possible in a core and the periphery section. in addition, you may carry out adjustable [of the amount of supply] in the middle of migration of the rinse nozzle 35 in this case in two steps, for example, may carry out until [1.2 l/min] adjustable from 0.5 l/min gradually above a three-stage.

[0066] Next, when making passing speed of the rinse nozzle 35 adjustable and seting constant the amount of supply and wafer rotational speed of a rinse, the rate of the rinse nozzle 35 in case a rinse is supplied to the periphery section of Wafer W is made smaller than the rate of the rinse nozzle 35 when being supplied by the wafer core. As shown in drawing 14 (b) as 1 operation gestalt, it considers as 7 mm/sec in a core, and is considering as 5 mm/sec in the periphery section. In this case, although that core differs in the peripheral velocity of Wafer W from the periphery section, the amount of supply of the rinse supplied to per unit time amount on a wafer side by changing the passing speed of the rinse nozzle 35 in this way can be made the same as much as possible in a core and the periphery section. in addition, you may carry out adjustable [of the passing speed] in the middle of migration of this rinse nozzle 35 in two steps, for example, may carry out until [5 mm/sec] adjustable from 7 mm/sec gradually above a three-stage.

[0067] Next, when making the rotational frequency of Wafer W adjustable and seting constant the passing speed of the rinse nozzle 35, and the amount of supply of a rinse, a wafer rotational frequency in case a rinse is supplied to the W round edge of wafers is made smaller than a rotational frequency in case a rinse is supplied by the wafer core. As shown in drawing 14 (c) as 1 operation gestalt, it is referred to as 1500rpm in a core, and is referred to as 1000rpm in the periphery section. In this case, the amount of supply of the rinse supplied to per unit time amount on a wafer side can be made the same as much as possible in a core and the periphery section. in addition, you may carry out adjustable [of the rotational frequency] in the middle of migration of this rinse nozzle 35 in two steps, for example, may carry out until [1000rpm] adjustable from 1500rpm gradually above a three-stage.

[0068] As mentioned above, the washing engine performance is made to homogeneity about the whole surface of a wafer by carrying out adjustable [of the flow rate of a rinse, the passing speed of the rinse nozzle 35, or the rotational frequency of Wafer W] in the middle of the migration on the wafer of the rinse nozzle 35 dynamically.

[0069] Next, with reference to drawing 15 - drawing 18 , the washing processing at the time of using the 2nd rinse nozzle 83 is explained.

[0070] In drawing 15 , breathing out a penetrant remover not using the 1st rinse nozzle 35 but moving only the 2 hydraulic nozzle 36 in the direction of a path of Wafer W from a core to the periphery section, a rinse is supplied to the core of a position W, for example, a wafer, by the 2nd rinse nozzle 83, and liquid membrane 51 is formed. It can prevent that cup rebound-phenomenon Myst generated by this when the 2 hydraulic nozzle 36 moves to the wafer periphery section adheres to Wafer W directly.

[0071] The 1st rinse nozzle 35 is not used in drawing 16 . First, although it is made to move to the periphery section from a core as shown in drawing 16 (a), breathing out a penetrant remover from the 2 hydraulic nozzles 36 to a wafer core, at this time, the rinse is not breathed out from the 2nd rinse nozzle 83. This is because it is rare for a penetrant remover to rebound upon Cup CP when the 2 hydraulic nozzle 36 starts the regurgitation of a penetrant remover from the center position of Wafer W as shown in drawing 16 (a). And while being able to prevent adhesion of rebound-phenomenon Myst by supplying a rinse and forming liquid membrane 51 at this time next since Myst of the cup rebound phenomenon increases when the 2 hydraulic nozzle 36 moves to near the periphery section of Wafer W as shown in drawing 16 (b), compared with the case in drawing 15 , the amount of the rinse used is reducible.

[0072] The 1st rinse nozzle 35 is not used in drawing 17 (a) and drawing 17 (b). While making it move to the periphery section from a core as first shown in drawing 17 (a), breathing out a penetrant remover from the 2 hydraulic nozzle 36, liquid membrane 51 is formed by rinse supply. And as shown in drawing 17 (b), when the 2 hydraulic nozzle 36 comes to the periphery section, according to the location where a penetrant remover is breathed out, adhesion of Myst in the wafer periphery section can be more certainly prevented by carrying out the supply location of a rinse near the wafer periphery section by changing the regurgitation include angle of the rinse of the 2nd rinse nozzle 83.
[0073] Drawing 18 is using both 1st and 2nd rinse nozzle 36 and 83. in this case, the 2 hydraulic nozzle 36 and the 1st rinse nozzle 35 — the periphery section from a core — while moving — a penetrant remover and a rinse — discharge — in addition to this, the rinse is further supplied also from the 2nd rinse nozzle 83. Liquid membrane 51 can be certainly formed all over wafer W by this, and adhesion of Myst can be prevented certainly.
[0074] Drawing 19 and drawing 20 are the top views and front views showing the whole washing processing-system configuration concerning 1 operation gestalt. In addition, in drawing 19 and drawing 20 , the sign same about the same thing as the component in drawing 1 and drawing 2 shall be attached, and the explanation is omitted.
[0075] The main wafer conveyance device 22 is arranged in four sets and a center section for the washing processing unit 50 for washing of Wafer W at the transverse-plane side of the processing station 11. This main wafer conveyance device 22 is adjoined, and the reverse unit (RVS) 90 which reverses a heat treatment unit (H.P.) and the cooling processing unit (COL) 91 required for the desiccation after washing, the transition unit (TRS) which delivers Wafer W between the cassette station 10 and the processing station 11, and the front flesh side of Wafer W is arranged. moreover — processing — a station — 11 — a tooth back — a side — **** — washing — a processing system — two — the whole — actuation - control — carrying out — a sake — electrical — a unit — (— EB —) — 93 — machine control — a unit — (— MB —) — 94 — washing — processing — a unit — 50 — using it — having — predetermined — a penetrant remover — storing — a drug solution — storage — a unit (CTB) — 92 — arranging — having — **** . Furthermore, the fan filter unit (FFU) 95 for carrying out the downflow of the air purer than the head-lining section is arranged in the processing station 11.
[0076] Such a washing processing system 2 can be used as washing dedicated system in processes other than the above-mentioned spreading development system 1. For example, as processes other than a spreading development process, specific gas or several sorts of compound gas is supplied on Wafer W. Although there is an etching process which only required thickness etches, the whole surface or the particular part of a thin film formed on the CVD process and wafer W front face in which a desired thin film is made to form by the chemical reaction in a wafer W front face It can use as an exclusive processing system for washing the wafer polluted during processing of these CVD(s) process or an etching process.
[0077] In addition, with this operation gestalt, although the washing processing system 2 was explained as a system of a simple substance, the CVD system used at the above-mentioned CVD process, the etching system used at an etching process, and the washing processing system 2 can be connected through an interface device etc., and it can be used as compound equipment made in-line.
[0078] This invention is not limited to the operation gestalt explained above, and various deformation is possible for it.
[0079] For example, in washing down stream processing shown in drawing 9 (a) and (b), when the 2 hydraulic nozzle 36 starts the regurgitation of a penetrant remover from the center position of Wafer W Since cup rebound-phenomenon Myst increases when the 2 hydraulic nozzle 36 comes to the wafer periphery section as it does not carry out, for example, is shown in drawing 9 (b), you may make it the regurgitation of the rinse from the rinse nozzle 35 supply a rinse like the case where it is shown in drawing 16 (a) and (b). When the 2 hydraulic nozzle 36 starts the regurgitation of a penetrant remover from the center position of Wafer W, that a penetrant remover rebounds upon Cup CP has little this, and when the 2 hydraulic nozzle 36 moves to near the periphery section of Wafer W, it is because it will be in the condition of being easy to

generate Myst of the rebound phenomenon. Thereby, the amount of the rinse used is reducible.
[0080] Moreover, in drawing 15 , drawing 16 (a), (b), and drawing 18 , although it was made to supply a wafer core, if the rinses from the rinse nozzle 83 are a penetrant remover by the 2 hydraulic nozzle 36, and the supply location in which it does not interfere, they will not be restricted to a wafer core.
[0081] Furthermore, with the above-mentioned operation gestalt, although the semi-conductor wafer was used as a substrate, this invention is applicable also about the glass substrate used not only for this but for a liquid crystal display etc.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view of the spreading development system concerning 1 operation gestalt of this invention.
[Drawing 2] It is the front view of the spreading development system shown in drawing 1 .
[Drawing 3] It is the rear view of the spreading development system shown in drawing 1 .
[Drawing 4] It is the top view of the washing processing unit concerning 1 operation gestalt of this invention.
[Drawing 5] It is the sectional view seen from [which is shown in drawing 4 / of a washing processing unit] X.
[Drawing 6] It is the sectional view seen from [which is shown in drawing 4 / of a washing processing unit] Y.
[Drawing 7] It is the sectional view of 2 hydraulic nozzles concerning 1 operation gestalt.
[Drawing 8] It is the flow Fig. showing washing down stream processing concerning 1 operation gestalt.
[Drawing 9] It is the side elevation showing washing down stream processing concerning 1 operation gestalt in order.
[Drawing 10] It is drawing which compared the particle elimination factor of a hydrophilic wafer by the existence of rinse supply.
[Drawing 11] It is drawing which compared the particle elimination factor of a hydrophobic wafer by the existence of rinse supply.
[Drawing 12] It is drawing which compared the particle rate of increase of a hydrophilic wafer by the existence of rinse supply.
[Drawing 13] It is drawing which compared the particle rate of increase of a hydrophobic wafer by the existence of rinse supply.
[Drawing 14] In a wafer core and the periphery section, it is drawing showing an example of each value at the time of each carrying out adjustable [of a rinse flow rate, rinse nozzle passing speed, or the wafer rotational frequency].
[Drawing 15] It is a side elevation at the time of using 2 hydraulic nozzles and the 2nd rinse nozzle.
[Drawing 16] In drawing 15 , it is a side elevation at the time of supplying a rinse from the migration middle of 2 hydraulic nozzles.
[Drawing 17] It is a side elevation at the time of carrying out adjustable [of the regurgitation include angle] for 2 hydraulic nozzles.
[Drawing 18] It is a side elevation at the time of using both 1st and 2nd rinse nozzles.
[Drawing 19] It is the top view showing the whole washing processing-system configuration concerning 1 operation gestalt.
[Drawing 20] It is the front view showing the whole washing processing-system configuration shown in drawing 19 .
[Description of Notations]
W -- Semi-conductor wafer
1 -- Spreading development system

31 — Driving pulley
32 — Bellows pump
33 — Control system
34 — Guide rail
35 — 1st rinse nozzle
36 — 2 hydraulic nozzles
38 — Stepping motor
39 — Rinse source of supply
40 — Connection member
41 — Belt
43 — Supply pipe
50 — Washing processing unit
51 — Liquid membrane
71a — Chuck plate
71b — Pivot
71c — Rotation drive motor
71d — Desorption device
72 — Connection table
77 — Nozzle maintenance arm
83 — 2nd rinse nozzle

[Translation done.]

* NOTICES *

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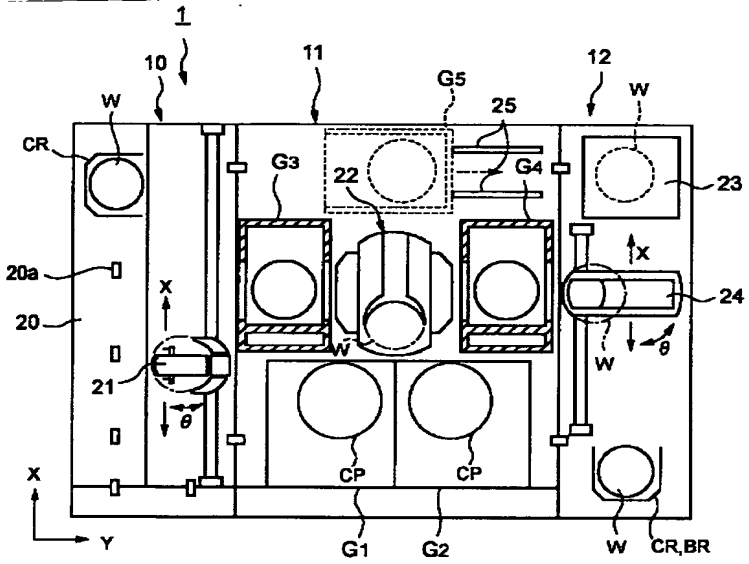
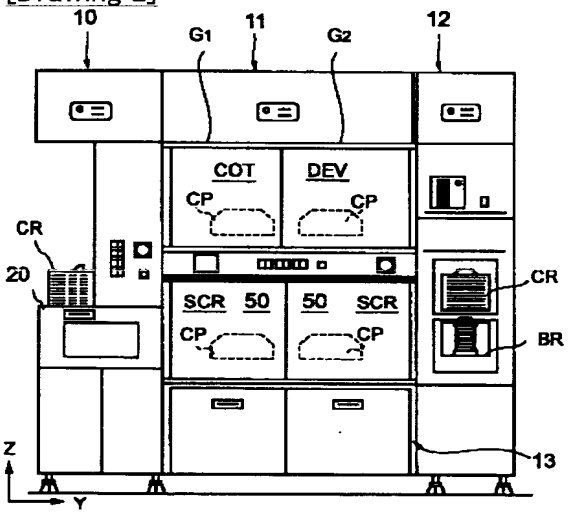
3.In the drawings, any words are not translated.

DRAWINGS

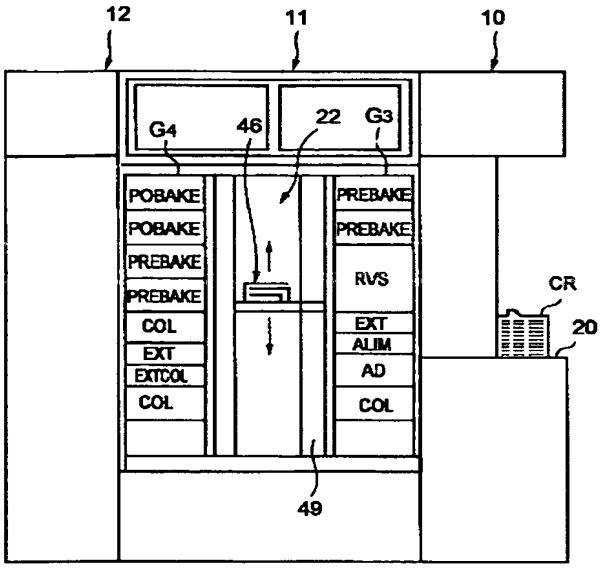
[Drawing 1]



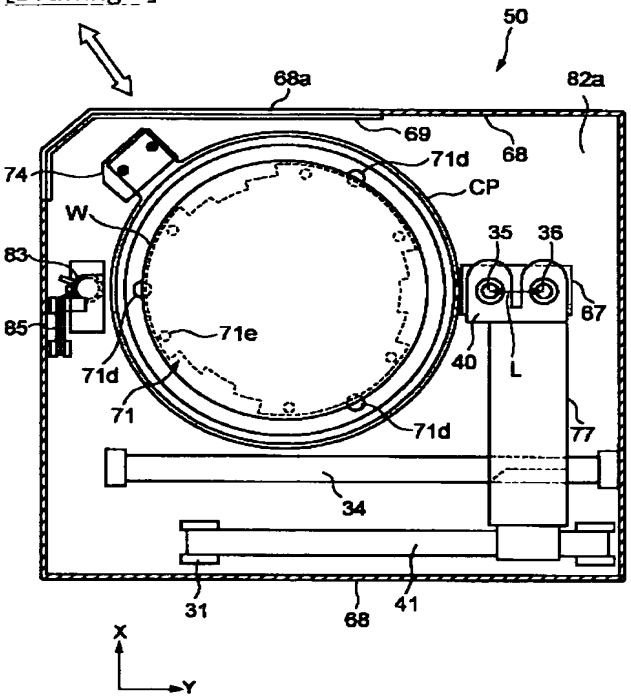
[Drawing 2]



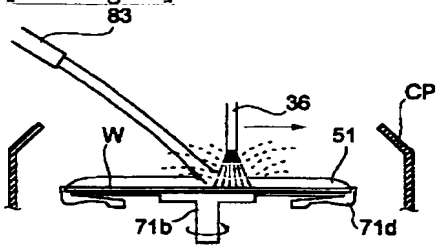
[Drawing 3]



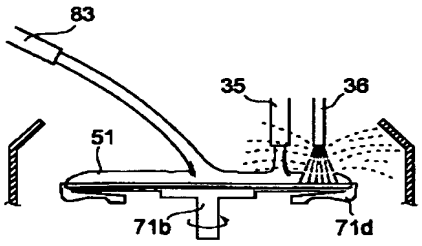
[Drawing 4]



[Drawing 15]



[Drawing 18]



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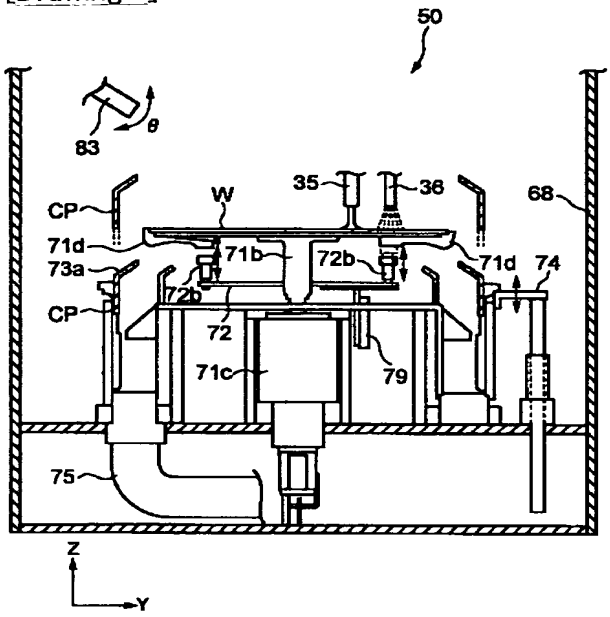

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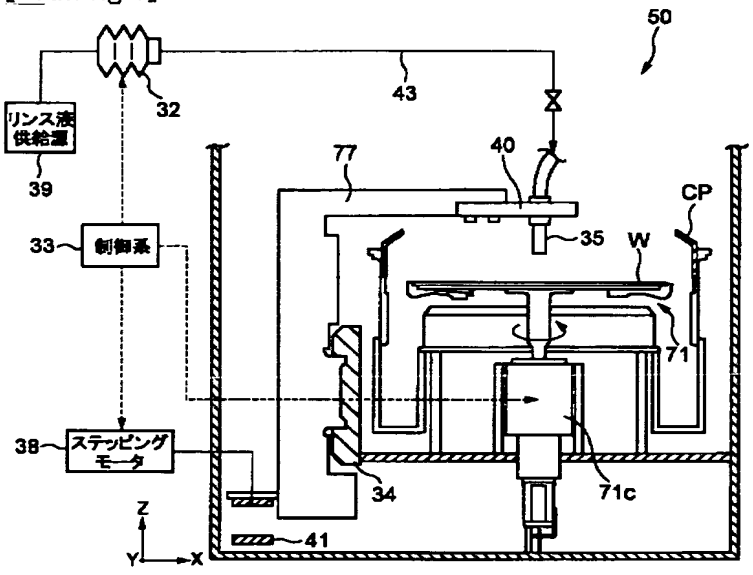
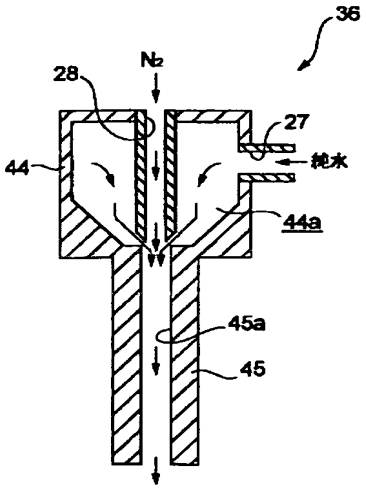
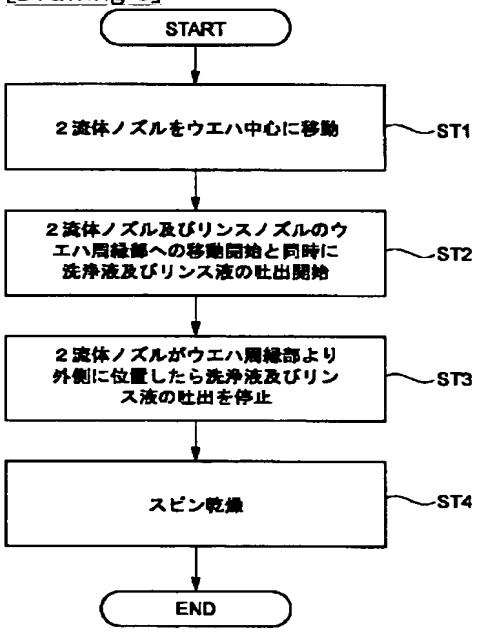


[Drawing 7]



[Drawing 8]



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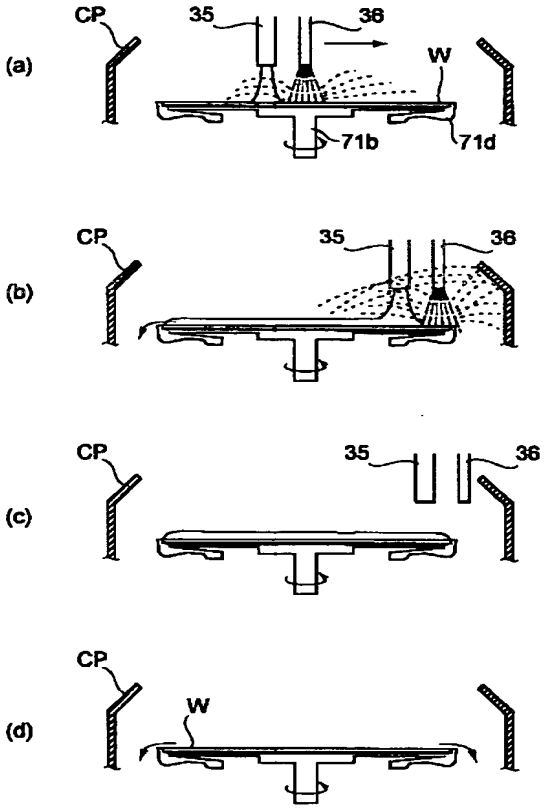

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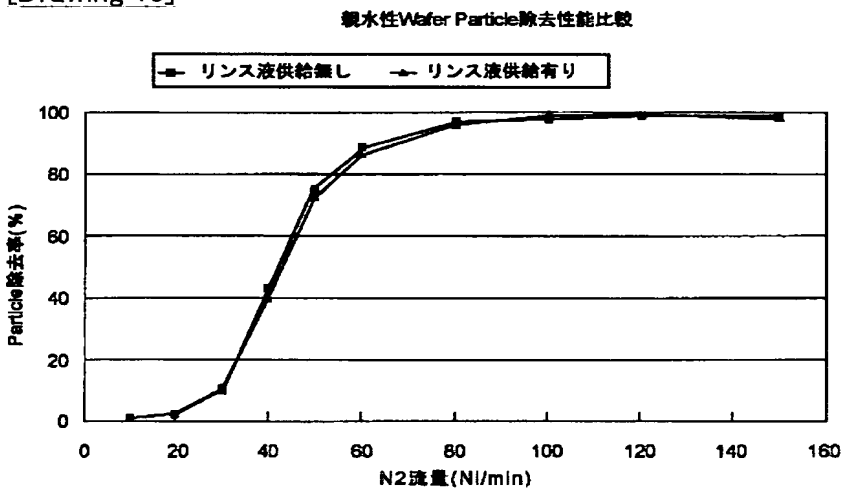

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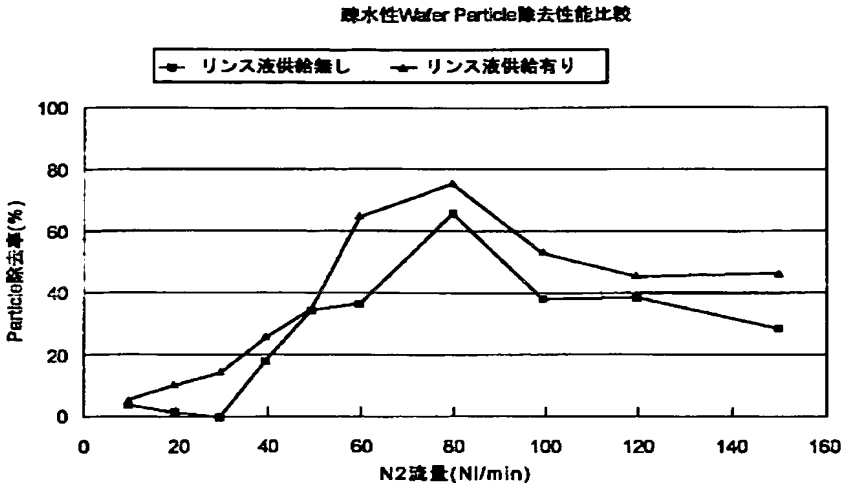

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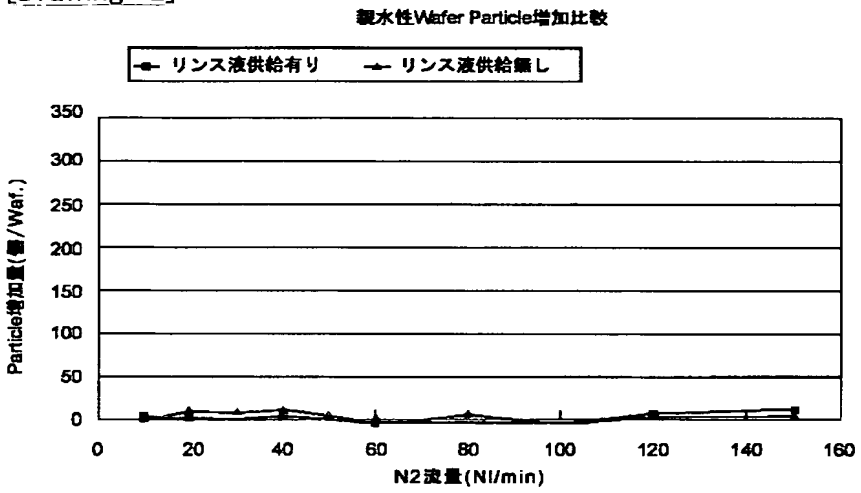


[Drawing 14]

リンス液流量

(a)

ウエハ中心部	0.5 l/min
ウエハ周縁部	1.2 l/min

リンスノズル移動速度

(b)

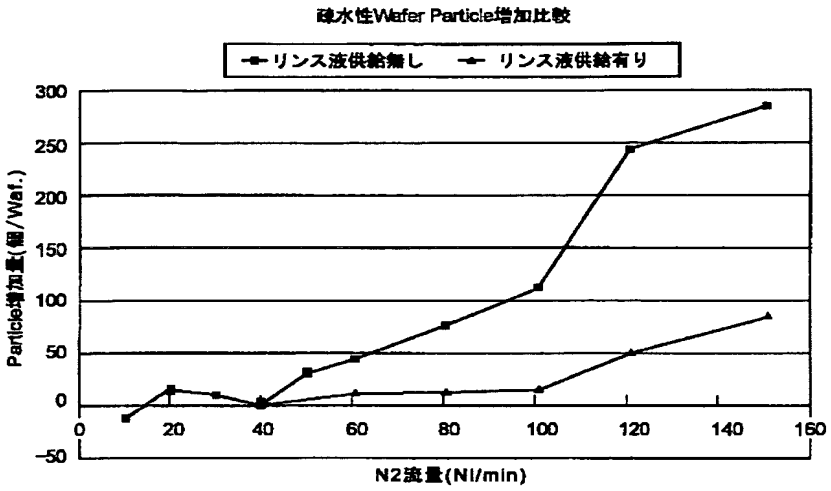
ウエハ中心部	7 mm/sec
ウエハ周縁部	5 mm/sec

ウエハ回転数

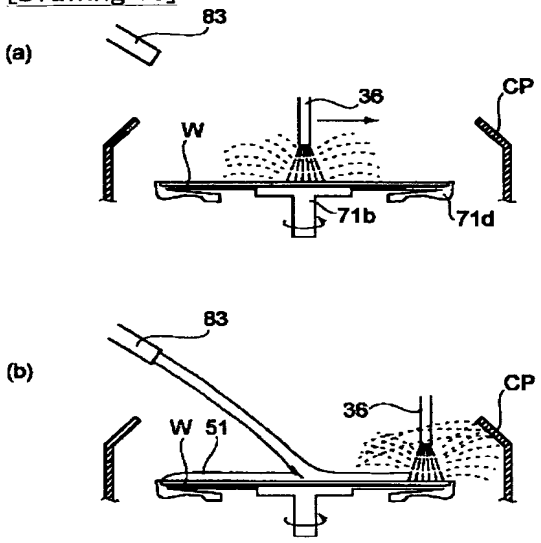
(c)

ウエハ中心部	1500 rpm
ウエハ周縁部	1000 rpm

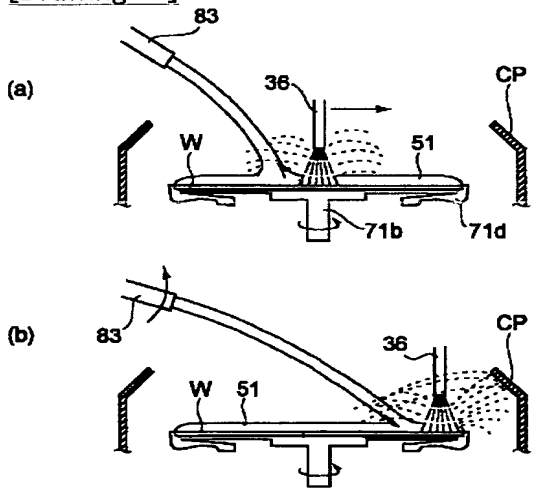
[Drawing 13]



[Drawing 16]



[Drawing 17]



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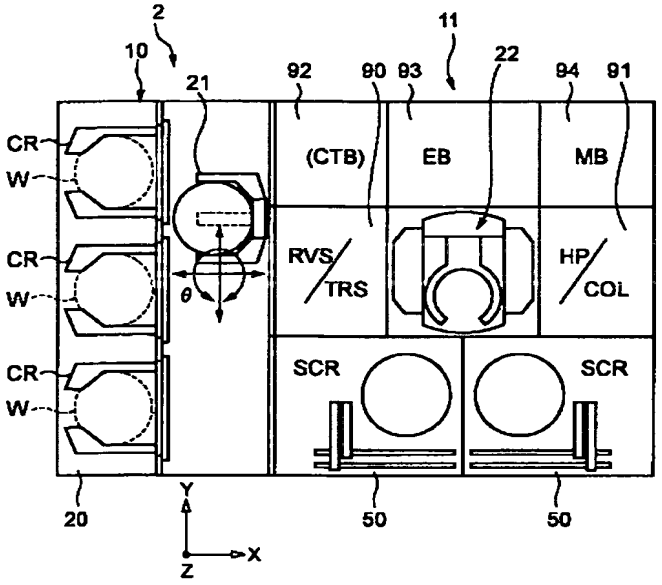
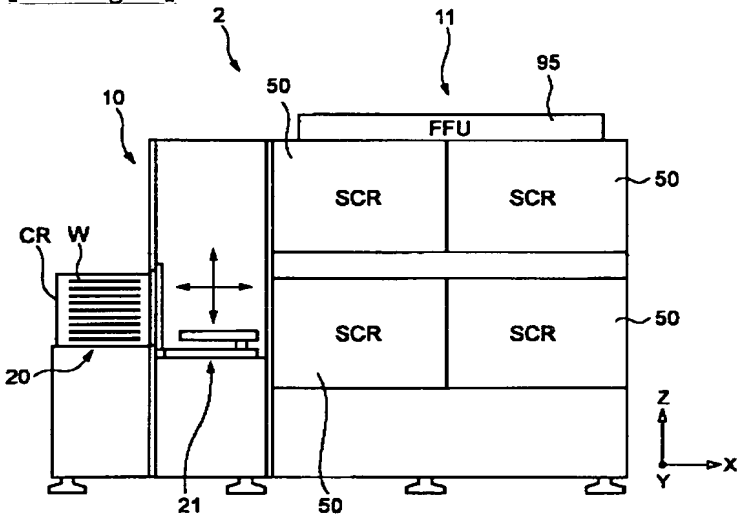


[Drawing 20]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（Ａ）**　(11)特許出願公開番号
特開2003－203892
（P2003－203892A）
(43)公開日　平成15年７月18日(2003.7.18)

(51)Int.Cl.⁷	識別記号	ＦＩ	ﾃｰﾏｺｰﾄﾞ(参考)
Ｈ０１Ｌ　21/304	６４３	Ｈ０１Ｌ　21/304	６４３Ｃ

審査請求　未請求　請求項の数25　ＯＬ　（全 15 頁）

(21)出願番号　特願2002－311928(P2002－311928)
(22)出願日　平成14年10月25日(2002.10.25)
(31)優先権主張番号　特願2001－336461(P2001－336461)
(32)優先日　平成13年11月１日(2001.11.1)
(33)優先権主張国　日本（ＪＰ）

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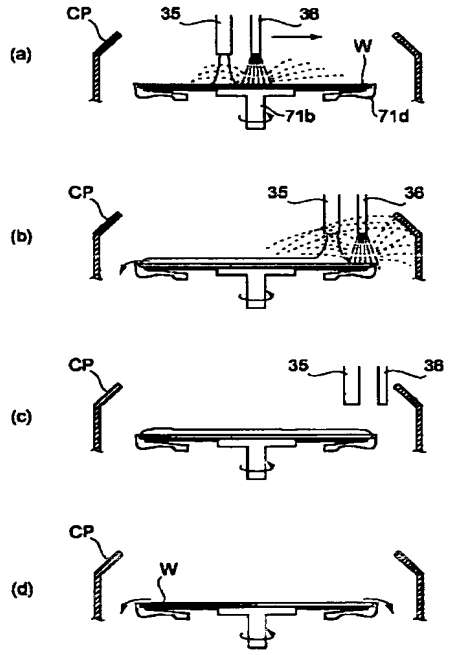
(54)【発明の名称】　基板洗浄装置及び基板洗浄方法

(57)【要約】
【課題】　親水性又は疎水性のいずれかの基板に関わらず、基板上へのパーティクルの付着を防止できる基板洗浄装置及び基板洗浄方法を提供すること。
【解決手段】　２流体ノズル３６から吐出された洗浄液がカップＣＰの内側で跳ね返り、ミスト状となってウエハＷの中心側へ向けて飛散するが、リンスノズル３５によりリンス液をウエハＷに供給して水膜５１を形成しているため、水膜５１上にミストが付着してもウエハ面に直接ミストが付着するわけではないので、ミストに含まれるパーティクルがウエハＷ上に付着することを防止でき、ウエハＷに対する悪影響を防止できる。



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【特許請求の範囲】

【請求項１】　基板を回転可能に保持する回転保持部と、

回転する基板上を径方向に移動可能に設けられ、洗浄液を吐出する洗浄ノズルと、

前記洗浄ノズルによる洗浄の際に、基板上に液体を供給し基板上に液膜を形成する液体供給ノズルとを具備することを特徴とする基板洗浄装置。

【請求項２】　請求項１に記載の基板洗浄装置において、

前記液体供給ノズルによって基板上に供給される液体は、前記洗浄ノズルより基板の回転中心側に供給されることを特徴とする基板洗浄装置。

【請求項３】　請求項１または請求項２に記載の基板洗浄装置において、

前記洗浄ノズルが基板の周縁部付近に移動したときに、前記液体供給ノズルによる液体の供給を開始するように制御する手段を更に具備することを特徴とする基板洗浄装置。

【請求項４】　請求項１から請求項３のうちいずれか１項に記載の基板洗浄装置において、

前記基板は、疎水性の基板であることを特徴とする基板洗浄装置。

【請求項５】　請求項１から請求項４のうちいずれか１項に記載の基板洗浄装置において、

前記液体供給ノズルによって基板上に供給される液体は、リンス液であることを特徴とする基板洗浄装置。

【請求項６】　請求項５に記載の基板洗浄装置において、

前記液体供給ノズルによって基板上に供給されるリンス液は、純水であることを特徴とする基板洗浄装置。

【請求項７】　請求項１から請求項６のうちいずれか１項に記載の基板洗浄装置において、

前記洗浄液は不活性ガスと液体との混合流体であることを特徴とする基板洗浄装置。

【請求項８】　請求項１から請求項７のうちいずれか１項に記載の基板洗浄装置において、

前記液体供給ノズルは、前記移動する洗浄ノズルと一体的に移動可能に配置されていることを特徴とする基板洗浄装置。

【請求項９】　請求項８に記載の基板洗浄装置において、

前記液体供給ノズルは、前記移動する洗浄ノズルに対し基板中心側に配置されることを特徴とする基板洗浄装置。

【請求項１０】　請求項８に記載の基板洗浄装置において、

前記洗浄ノズルと液体供給ノズルとの距離は５ｍｍ～８０ｍｍであることを特徴とする基板洗浄装置。

【請求項１１】　請求項８から請求項１０のうちいずれか１項に記載の基板洗浄装置において、

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前記基板の周縁部に供給される液体の流量を、基板中心部に供給される液体の流量よりも多くするように制御する手段を更に具備することを特徴とする基板洗浄装置。

【請求項１２】　請求項８から請求項１０のうちいずれか１項に記載の基板洗浄装置において、

前記基板の周縁部に前記液体が供給されるときの液体供給ノズルの速度を、基板中心部に供給されるときの液体供給ノズルの速度よりも小さくするように制御する手段を更に具備することを特徴とする基板洗浄装置。

【請求項１３】　請求項８から請求項１０のうちいずれか１項に記載の基板洗浄装置において、

前記基板の周縁部に前記液体が供給されるときの基板の回転数を、基板中心部に前記液体が供給されるときの回転数よりも小さくするように制御する手段を更に具備することを特徴とする基板洗浄装置。

【請求項１４】　請求項７に記載の基板洗浄装置において、

前記洗浄液の不活性ガスの流量は、１０Ｎｌ／ｍｉｎ～２００Ｎｌ／ｍｉｎであることを特徴とする基板洗浄装置。

【請求項１５】　請求項１４に記載の基板洗浄装置において、

前記洗浄液の不活性ガスの流量は、８０Ｎｌ／ｍｉｎであることを特徴とする基板洗浄装置。

【請求項１６】　請求項１に記載の基板洗浄装置において、

前記液体供給ノズルによって供給される前記液体の流量は、０．５ｌ／ｍｉｎ～１．２ｌ／ｍｉｎであることを特徴とする基板洗浄装置。

【請求項１７】　請求項１６に記載の基板洗浄装置において、

前記液体供給ノズルの速度は、５ｍｍ／ｓｅｃ～３０ｍｍ／ｓｅｃであることを特徴とする基板洗浄装置。

【請求項１８】　請求項１に記載の基板洗浄装置において、

前記基板の回転数は、３００ｒｐｍ～５０００ｒｐｍであることを特徴とする基板洗浄装置。

【請求項１９】　基板を回転可能に保持する回転保持部と、

回転する基板上を径方向に移動可能に設けられ、洗浄液を吐出する洗浄ノズルと、

前記移動する洗浄ノズルと一体的に移動可能に配置され、前記洗浄ノズルによる洗浄の際に、基板上に液体を供給し基板上に液膜を形成する第１の液体供給ノズルと、

前記洗浄ノズルによる洗浄の際に、前記基板の所定の位置に液体を供給し前記第１の液体供給ノズルとともに基板上に液膜を形成する第２の液体供給ノズルとを具備することを特徴とする基板洗浄装置。

【請求項２０】　請求項１９に記載の基板洗浄装置において、
前記洗浄ノズルが前記基板の周縁部付近に移動したときに、前記第２の液体供給ノズルによる液体の供給を行うように制御する手段を具備することを特徴とする基板洗浄装置。
【請求項２１】　請求項２０に記載の基板洗浄装置において、
前記第２の液体供給ノズルにより供給される液体は、基板の中心部に供給されることを特徴とする基板洗浄装置。
【請求項２２】　回転する基板上に洗浄液を吐出する工程と、
前記洗浄工程の際、該基板上に液体を供給して基板上に液膜を形成する工程とを具備することを特徴とする基板洗浄方法。
【請求項２３】　請求項２２に記載の基板洗浄方法において、
前記洗浄液は不活性ガスと所定の液体との混合流体であって、この洗浄液を吐出する洗浄ノズルを具備することを特徴とする基板洗浄方法。
【請求項２４】　請求項２３に記載の基板洗浄方法において、
前記洗浄ノズルは、前記回転する基板上を径方向に移動可能に設けられ、
前記洗浄ノズルの移動の際、洗浄液が吐出される基板上の位置より中心側に前記液体が供給されることを特徴とする基板洗浄方法。
【請求項２５】　請求項２４に記載の基板洗浄方法において、
前記洗浄ノズルが前記基板の周縁部付近に移動したときに、前記液体の供給を開始する工程を更に具備することを特徴とする基板洗浄方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、半導体デバイスの製造において、半導体ウエハ基板を洗浄する基板洗浄装置及び基板洗浄方法に関する。
【０００２】
【従来の技術】半導体デバイスの製造においては、半導体ウエハ（以下、「ウエハ」という）の表裏面、特に半導体デバイスが形成されるウエハの表面の清浄度を高く維持する必要があり、このため、種々の製造プロセスの前後でウエハの表裏面の洗浄が行われている。
【０００３】特に、フォトリソグラフィ工程においては、ウエハの表裏面の洗浄は不可欠であり、例えば、洗浄液の飛散を防止したり使用後の洗浄液を収集して廃棄したりするためのカップ内にウエハを収容し、このカップ内でウエハを回転させそのウエハ上面に洗浄液を供給しながら、回転するブラシをウエハ上面に当接しつつウエハの中心部と周縁部との間で往復移動させることで、ウエハ上面に付着したパーティクル等の汚染物質を除去するスクラブ洗浄が行われている。

【０００４】また、近年では、このスクラブ洗浄において、回転ブラシによる洗浄だけでなく、例えばウエハ上に超音波洗浄水や、不活性ガスと純水とを混合した混合流体（２流体）等をノズルによりジェット噴射し、より微細なパーティクルを除去するようにしている。（例えば、特許文献１参照。）。
【０００５】
【特許文献１】特開平１０－１５６２２９号公報（図１等）。
【０００６】
【発明が解決しようとする課題】しかしながら、超音波洗浄水や２流体等の洗浄液をジェット噴射してウエハを洗浄する場合、特にウエハを収容したカップの内壁面でジェット噴射の洗浄水がミスト状となって跳ね返ることにより、当該カップの内壁面に付着したパーティクル等をまき散らし、このようにまき散らされたパーティクルがウエハに付着する。すなわち、本来カップは、ウエハ洗浄中に洗浄液が周囲に飛散するのを防止したり、洗浄液がカップの内壁面に沿って下方に流れ落ちる、という機能を有しているが、超音波洗浄水や２流体等の洗浄水を使用した場合、これらの洗浄水は流量が多く噴射勢いが強いので、カップ内壁面で跳ね返ってしまう。
【０００７】この場合、例えば処理対象であるウエハが親水性のウエハである場合には、ウエハに付着したパーティクルを含む洗浄液のウエハ表面に対する接触角が小さく、当該洗浄液はパーティクルとともにウエハから流れ落ちやすい状態となるので問題はない。しかし、処理対象であるウエハが疎水性のウエハである場合には、洗接触角が大きく濡れ性が悪いので、洗浄液の吐出途中であるにも関わらずウエハ面が露出し、ウエハ面に直接ミスト状のパーティクルが付着してしまいこれを除去できない。
【０００８】以上のような事情に鑑み、本発明の目的は、親水性又は疎水性のいずれかの基板に関わらず、当該基板上へのパーティクルの付着を防止できる基板洗浄装置及び基板洗浄方法を提供することにある。
【０００９】
【課題を解決するための手段】上記目的を達成するため、本発明の第１の観点に係る基板洗浄装置は、基板を回転可能に保持する回転保持部と、回転する基板上を径方向に移動可能に設けられ、洗浄液を吐出する洗浄ノズルと、前記洗浄ノズルによる洗浄の際に、基板上に液体を供給し基板上に液膜を形成する液体供給ノズルとを具備する。
【００１０】このような構成によれば、基板上に、基板に対して親水性の液膜を形成させながら洗浄液を吐出して洗浄を行っているので、例えば疎水性の基板を使用し

た場合であって、この基板をカップ内に収容して洗浄処理を行う場合には、このカップから跳ね返る洗浄液のミストが当該親水性の液膜上に付着し、このミストに含まれるパーティクルは回転する基板の遠心力により液膜とともに基板の外に排出される。これにより、直接基板上にパーティクルが付着することを防止できる。

【００１１】ここで、「親水性の液膜を形成」とは、基板表面を親水性の膜を形成するという意味である。すなわち、液膜を基板上に形成することにより、疎水性の基板表面があたかも親水性になることを意味する。

【００１２】本発明の一の形態によれば、前記液体供給ノズルによって基板上に供給される液体は、前記洗浄ノズルより基板の回転中心側に供給される。

【００１３】本発明の一の形態によれば、前記洗浄ノズルが基板の周縁部付近に移動したときに、前記液体供給ノズルによる液体の供給を開始するように制御する手段を更に具備する。

【００１４】本発明の一の形態によれば、前記基板は、疎水性の基板である。

【００１５】本発明の一の形態によれば、前記液体供給ノズルによって基板上に供給される液体は、リンス液である。

【００１６】本発明の一の形態によれば、前記液体供給ノズルによって基板上に供給されるリンス液は、純水である。

【００１７】本発明の一の形態によれば、前記洗浄液は不活性ガスと液体との混合流体である。この不活性ガスとして例えば窒素ガスを用い、また、液体として純水を用い、このガスの吐出圧と純水とにより基板の洗浄処理を行うようにしているので、洗浄ノズルによる洗浄液の飛散量が多くミストが発生しやすい状況となる。この場合に、本発明の液膜形成によるミスト付着防止効果は大きい。ここで、洗浄液の不活性ガスの流量は、１０Ｎｌ／ｍｉｎ～２００Ｎｌ／ｍｉｎとする。より好ましくは、８０Ｎｌ／ｍｉｎである。

【００１８】本発明の一の形態によれば、前記液体供給ノズルは、前記移動する洗浄ノズルと一体的に移動可能に配置されている。また、この場合、前記液体供給ノズルは、前記移動する洗浄ノズルに対し基板中心側に配置され、更に、前記洗浄ノズルと液体供給ノズルとの距離は５ｍｍ～８０ｍｍとすることが好ましい。このように移動して洗浄液を吐出する洗浄ノズルの基板中心側に、液体供給ノズルを配置し、洗浄液が基板に供給される位置よりも基板中心側に永代を供給するようにしたので、例えば、洗浄ノズルが基板周縁部から外側に外れていく場合であっても、液体供給ノズルは、常に基板周縁部に液体を供給して液膜を形成している。従って、特にカップからの跳ね返りミストが多い基板周縁部にパーティクルが付着することを防止できる。また、液体としてリンス液を使用した場合にも同様の効果が得られる。

【００１９】本発明の一の形態によれば、前記基板の周縁部に供給される液体の流量を、基板中心部に供給される液体の流量よりも多くするように制御する手段をさらに具備する。あるいは、前記基板の周縁部に前記液体が供給されるときの液体供給ノズルの速度を、基板中心部に供給されるときの液体供給ノズルの速度よりも小さくするように制御する手段を更に具備する。基板の回転速度がその中心部と周縁部とで異なるが、このように液体の流量又は液体供給ノズルの移動速度を変えることで、基板面上の単位時間当りに供給される液体の供給量を中心部と周縁部とで可及的に同じにすることができる結果、基板全面で洗浄性能を均一にすることができる。ここで、液体の流量は、０．５ｌ／ｍｉｎ～１．２ｌ／ｍｉｎとし、液体供給ノズルの速度は、５ｍｍ／ｓｅｃ～３０ｍｍ／ｓｅｃとすることが好ましい。

【００２０】本発明の一の形態によれば、前記基板の周縁部に前記液体が供給されるときの基板の回転数を、基板中心部に前記液体が供給されるときの回転数よりも小さくするように制御する手段を更に具備する。このように液体の供給位置に対応して基板の回転速度を可変しているので、基板面上の単位時間当りに供給される液体の供給量を中心部と周縁部とで可及的に同じにすることができる結果、基板全面で洗浄性能を均一にすることができる。ここで、基板の回転数は、３００ｒｐｍ～５００ｒｐｍとすることが好ましい。

【００２１】本発明の第２の観点に係る基板洗浄装置は、基板を回転可能に保持する回転保持部と、回転する基板上を径方向に移動可能に設けられ、洗浄液を吐出する洗浄ノズルと、前記移動する洗浄ノズルと一体的に移動可能に配置され、前記洗浄ノズルによる洗浄の際に、基板上に液体を供給し基板上に液膜を形成する第１の液体供給ノズルと、前記洗浄ノズルによる洗浄の際に、前記基板の所定の位置に液体を供給し前記第１の液体供給ノズルとともに基板上に液膜を形成する第２の液体供給ノズルとを具備する。

【００２２】このような構成によれば、第１の液体供給ノズルを洗浄ノズルとともに一体的に移動させ、基板上に親水性の液膜を形成させながら洗浄液を吐出して、特に洗浄ノズル近傍の液膜形成を確実に行い、更に、第２の液体供給ノズルにより、例えば基板中心部に液体を供給して基板全面に確実に液膜形成を行う。その結果、例えば疎水性の基板を使用した場合であって、この基板をカップ内に収容して洗浄処理を行う場合には、このカップから跳ね返る洗浄液のミストが当該親水性の液膜上に付着し、このミストに含まれるパーティクルは回転する基板の遠心力により液膜とともに基板の外に排出される。これにより、直接基板上にパーティクルが付着することを防止できる。

【００２３】本発明の一の形態によれば、前記洗浄ノズルが前記基板の周縁部付近に移動したときに、前記第２

の液体供給ノズルによる液体の供給を行うように制御する手段を具備する。これにより、カップ跳ね返りのミストの付着を防止できるとともに、例えば液体にリンス液を使用した場合、リンス液の使用量を削減できる。

【００２４】本発明の基板洗浄方法は、回転する基板上に洗浄液を吐出する工程と、前記洗浄工程の際、該基板上に液体を供給して基板上に液膜を形成する工程とを具備する。

【００２５】このような構成によれば、基板上に親水性の液膜を形成させながら洗浄液を吐出して洗浄を行っているので、例えば疎水性の基板を使用した場合であっても、直接基板上にパーティクルが付着することを防止できる。

【００２６】本発明の基板処理システムは、基板上にレジストを塗布する塗布処理部と、前記レジストが塗布された基板に現像処理を行う現像処理部と、基板に熱的な処理を施す熱処理部と、基板を回転可能に保持する回転保持部と、回転する基板上を径方向に移動可能に設けられ、洗浄液を吐出する洗浄ノズルと、前記洗浄ノズルによる洗浄の際に、基板上に液体を供給し基板上に液膜を形成する液体供給ノズルとを有する基板洗浄装置と、前記塗布処理部、現像処理部、熱処理部及び基板洗浄装置の間で基板の搬送を行う搬送機構とを具備する。

【００２７】このような構成によれば、レジスト塗布処理、現像処理、熱処理等を含むフォトリソグラフィ工程において、前記基板洗浄装置を塗布処理部、現像処理部及び熱処理部と一体化して、搬送機構により基板を各処理部及び処理装置に自動搬送することにより、スループットの向上が図れる。

【００２８】

【発明の実施の形態】以下、本発明の実施の形態を図面に基づき説明する。

【００２９】図１～図３は本発明に係る塗布現像処理システムの全体構成を示す図であり、図１はその平面図、図２は正面図及び図３は背面図である。

【００３０】この塗布現像処理システム１は、被処理基板として半導体ウエハＷをウエハカセットＣＲで複数枚例えば２５枚単位で外部からシステムに搬入し又はシステムから搬出したり、ウエハカセットＣＲに対してウエハＷを搬入・搬出したりするためのカセットステーション１０と、塗布現像工程の中で１枚ずつウエハＷに所定の処理を施す枚葉式の各種処理ユニットを所定位置に多段配置してなる処理ステーション１１と、この処理ステーション１１と隣接して設けられる露光装置（図示せず）との間でウエハＷを受け渡しするためのインターフェース部１２とを一体に接続した構成を有している。

【００３１】カセットステーション１０では、図１に示すように、カセット載置台２０上の突起２０ａの位置に複数個例えば４個までのウエハカセットＣＲがそれぞれのウエハ出入口を処理ステーション１１側に向けてＸ方向一列に載置され、カセット配列方向（Ｘ方向）及びウエハカセットＣＲ内に収納されたウエハのウエハ配列方向（Ｚ方向）に移動可能なウエハ搬送体２１が各ウエハカセットＣＲに選択的にアクセスするようになっている。さらに、このウエハ搬送体２１は、θ方向に回転可能に構成されており、後述するように処理ステーション１１側の第３の組Ｇ３の多段ユニット部に属するアライメントユニット（ＡＬＩＭ）及びイクステンションユニット（ＥＸＴ）にもアクセスできるようになっている。

【００３２】処理ステーション１１では、図１に示すように、中心部に垂直搬送型の主ウエハ搬送機構２２が設けられ、その周りに全ての処理ユニットが１組または複数の組に亙って多段に配置されている。この例では、５組Ｇ１，Ｇ２，Ｇ３，Ｇ４，Ｇ５の多段配置構成であり、第１及び第２の組Ｇ１，Ｇ２の多段ユニットはシステム正面（図１において手前）側に並置され、第３の組Ｇ３の多段ユニットはカセットステーション１０に隣接して配置され、第４の組Ｇ４の多段ユニットはインターフェース部１２に隣接して配置され、第５の組Ｇ５の多段ユニットは背部側に配置されている。なお第５の組Ｇ５は、主ウエハ搬送機構２２のメンテナンスのためにレール２５に沿って移動可能に構成されている。

【００３３】主ウエハ搬送機構２２は、筒状支持体４９の内側に、ウエハ搬送装置４６を上下方向（Ｚ方向）に昇降自在に装備している。筒状支持体４９はモータ（図示せず）の回転軸に接続されており、このモータの回転駆動力によって、前記回転軸を中心としてウエハ搬送装置４６と一体に回転し、これによりこのウエハ搬送装置４６は、θ方向に回転自在となっている。

【００３４】図２に示すように、第１の組Ｇ１では、カップＣＰ内でウエハＷをスピンチャックに載せて所定の処理を行う２台のスピンナ型処理ユニット、例えばレジスト塗布処理ユニット（ＣＯＴ）及び本発明に係る基板洗浄装置としての洗浄処理ユニット５０が下から順に２段に重ねられている。第２の組Ｇ２では、２台のスピンナ型処理ユニット、例えば現像処理ユニット（ＤＥＶ）及び第１の組Ｇ１と同様の洗浄処理ユニット５０が下から順に２段に重ねられている。

【００３５】図３に示すように、第３の組Ｇ３では、ウエハＷを載置台に載せて所定の処理を行うオーブン型の処理ユニット、例えば下から順にクーリングユニット（ＣＯＬ）、アドヒージョンユニット（ＡＤ）、アライメントユニット（ＡＬＩＭ）、イクステンションユニット（ＥＸＴ）、リバースユニット（ＲＶＳ）及びプリベーキングユニット（ＰＲＥＢＡＫＥ）が重ねられている。第４の組Ｇ４でも、オーブン型の処理ユニット、例えば下から順にクーリングユニット（ＣＯＬ）が2段，イクステンション・クーリングユニット（ＥＸＴＣＯＬ）、イクステンションユニット（ＥＸＴ）、プリベーキングユニット（ＰＲＥＢＡＫＥ）及びポストベーキン

グユニット（ＰＯＢＡＫＥ）が重ねられている。

【００３６】このように処理温度の低いクーリングユニット（ＣＯＬ）、（ＥＸＴＣＯＬ）を下段に配置し、処理温度の高いベーキングユニット（ＰＲＥＢＡＫＥ）やポストベーキングユニット（ＰＯＢＡＫＥ）を上段に配置することで、ユニット間の熱的な相互干渉を少なくすることができる。しかし、ランダムな多段配置とすることも可能である。

【００３７】インターフェース部１２は、奥行方向では処理ステーション１１と同じ寸法を有するが、幅方向では小さなサイズにつくられている。インターフェース部１２の正面部には可搬性のピックアップカセットＣＲと定置型のバッファカセットＢＲが２段に配置され、背面部には周辺露光装置２３が配設され、中央部にはウエハ搬送体２４が設けられている。このウエハ搬送体２４は、Ｘ，Ｚ方向に移動して両カセットＣＲ，ＢＲ及び周辺露光装置２３にアクセスするようになっている。さらに、ウエハ搬送体２４は、θ方向に回転可能に構成され、処理ステーション１１側の第４の組Ｇ４の多段ユニットに属するイクステンションユニット（ＥＸＴ）にも、及び隣接する露光装置側のウエハ受渡し台（図示せず）にもアクセスできるようになっている。

【００３８】図４は、上記洗浄処理ユニット５０の概略構造を示す平面図、図５は図４においてＸ方向から見た断面図、図６は図４においてＹ方向から見た断面図である。

【００３９】この洗浄処理ユニット５０のケース６８には、主ウエハ搬送機構２２の搬送アームがウエハを搬入出するための開口部６８ａが形成され、この開口部６８ａには開閉機構を有するシャッタ部材６９が配置されている。

【００４０】ユニット中央部には、ウエハＷの周縁部を囲繞するようにウエハＷを収容するカップＣＰが配置されており、このカップＣＰは、昇降機構７４により昇降自在に構成され、主ウエハ搬送機構２２との間でウエハの受け渡しを行う場合には下降位置に配置され、後述する洗浄処理中においては上昇位置に配置されるようになっている。これにより、洗浄処理中に発生したミスト化した洗浄液がカップＣＰの外部に向けて拡散することを防止できる。

【００４１】このカップＣＰ内には、ウエハＷを保持して回転させるスピンチャック７１が設けられている。このスピンチャック７１は、チャックプレート７１ａと、このチャックプレート７１ａを支持する枢軸７１ｂと、この枢軸７１ｂを回転させる回転駆動モータ７１ｃと、チャックプレート７１ａにおいてウエハＷの脱着を行う脱着機構７１ｄとを有する。また、チャックプレート７１ａの表面には、支持ピン７１ｅ（図４において６箇所）配設されており、このウエハＷはこの支持ピン７１ｅの頂点に接して載置されるようになっている。回転駆動モータ７１ｃは、回転数が調整可能となっており、例えば０ｒｐｍ～５０００ｒｐｍの範囲で動的に可変できるようになっている。

【００４２】チャックプレート７１ａの周縁３箇所には、ウエハＷの脱着機構７１ｄが配設されている。ここで、図５において左側の脱着機構７１ｄはウエハＷを保持した状態が示されており、図５において右側の脱着機構７１ｄはウエハＷを保持していない状態を示している。チャックプレート７１ａの下方部には、昇降シリンダ７９により昇降可能な１枚の連結テーブル７２が設けられ、この連結テーブル７２上において脱着機構７１ｄの配設位置にそれぞれ対応する３箇所には、当接治具７２ｂが配設されている。昇降シリンダ７９によって当接治具７２ｂを上昇させると当接治具７２ｂが脱着機構７１ｄにそれぞれ当接して押圧することにより、図５中右側の脱着機構７１ｄのようにウエハＷの保持状態を解除し、逆に当接治具７２ｂを下降させると図示しない弾性部材により、図５中左側の脱着機構７１ｄのようにウエハＷを保持するようになっている。

【００４３】カップＣＰの内周側底部にはドレイン７５が設けられており、カップＣＰ内の排気及び洗浄液やリンス液の排出が行われるようになっている。この排気に関しては、例えば図示しないバキューム装置により排気されるようになっており、主ウエハ搬送機構２２との間でのウエハの受け渡しの際は排気を弱めるか又は停止することにより、受け渡しの際の機械的動作により発生するパーティクルのカップＣＰ内への引き込みを防止することができる。

【００４４】カップＣＰの側方部には、ノズル待機位置６７に待機された第１の液体供給ノズルである第１のリンスノズル３５及び洗浄ノズルとしての２流体ノズル３６が一体的に連結部材４０に固定されている。これらの第１のリンスノズル３５と２流体ノズル３６との間の距離は、例えば５ｍｍ～８０ｍｍとされている。

【００４５】図６を参照して、第１のリンスノズル３５にはリンス液供給源３９から供給管４３を介してリンス液としての例えば純水が供給されるようになっており、例えばベローズポンプ３２によりノズル３５からの当該リンス液の供給量が動的に可変できるようになっている。本実施形態では、リンス液供給量は例えば０．５１／ｍｉｎ～１．２１／ｍｉｎとされている。

【００４６】２流体ノズル３６は、図７に示すように、バッファ室４４ａを備えたバッファ部４４と、洗浄液を吐出する吐出部４５とを有している。バッファ室４４ａには例えば不活性ガスとして窒素ガスを当該バッファ室４４ａに供給するための窒素ガス流路２８と、純水を供給するための液流路２７が形成されている。吐出部４５には、バッファ室４４ａにおける窒素ガス流路２８の出口付近で純水と混合された混合流体（窒素ガスを含む純水）を勢いよくウエハ上に吐出するための流路４５ａが

形成されている。

【００４７】図６を参照して、これら第１のリンスノズル３５と２流体ノズル３６とを固定した連結部材４０は、Ｙ方向に延設されたガイドレール３４に沿って移動可能なノズル保持アーム７７に取り付けられている。この保持アーム７７は、例えばステッピングモータ３８により駆動プーリ３１を介して駆動するベルト４１に接続されており、ステッピングモータ３８の回転数によって保持アーム７７の移動速度が可変に構成され、これにより、第１のリンスノズル３５及び２流体ノズル３６の移動速度が可変になっている。本実施形態では、この移動速度は５ｍｍ／ｓｅｃ～１０ｍｍ／ｓｅｃとされている。なお、保持アーム７７は、図示しない昇降機構により昇降可能とされており、両ノズル３５、３６の高さ位置が調節できるようになっている。

【００４８】上記回転駆動モータ７１ｃの回転数、ベローズポンプ３２の作動量及びステッピングモータ３８の回転数は制御系３３により統合的に制御されるようになっており、例えば保持アーム７７の移動速度に基づいて第１のリンスノズル３５からのリンス液供給量を動的に可変でき、また、回転駆動モータ７１ｃの回転数に基づいてリンス液供給量を動的に可変できるようになっている。

【００４９】カップＣＰの外側上部にも、上記第１のリンスノズル３５と同様に、ウエハＷ上に液体を供給する第２の液体供給ノズルのである第２のリンスノズル８３が配置されている。この第２のリンスノズル８３からは、リンス液として例えば純水が供給される。この第２のリンスノズル８３は、高さ・方向調節機構８５により、Ｚ方向高さ及びリンス液の吐出角度を変えることが可能となっている。

【００５０】ここで、液体供給ノズルからは、例えば洗浄液と同じ液体、本実施の形態の場合純水が供給される。洗浄液が薬液を含む場合、液体供給ノズルから同じ薬液を供給すると濃度変化がないという効果がある。また、ミストのカップへの付着物の薬液濃度を減少させる効果を求める場合、純水や洗浄液より濃度の低い薬液を使うことも考えられる。また、純水は洗浄後のリンス液としても使用される。

【００５１】次に、以上説明した塗布現像処理システム１における一連の処理工程について説明する。

【００５２】先ず、カセットステーション１０において、ウエハ搬送体２１がカセット載置台２０上の処理前のウエハを収容しているカセットＣＲにアクセスして、そのカセットＣＲから１枚のウエハＷを取り出し、アライメントユニット（ＡＬＩＭ）に搬送される。このアライメントユニット（ＡＬＩＭ）にてウエハＷの位置合わせが行われた後、主ウエハ搬送機構２２によりウエハＷは、リバースユニット（ＲＶＳ）へ搬送され、ウエハにおいてデバイスが形成される面である表面が下になるように裏面を上に向けて反転させる。そして洗浄処理ユニット５０へ搬送され、裏面側の洗浄処理が行われる。その後、再びウエハＷはリバースユニット（ＲＶＳ）へ搬送され、今度は表面が上になるように反転させ、再び洗浄処理ユニット５０へ搬送され所定の洗浄処理が行われる。このウエハＷの洗浄処理については後述する。なお、必要に応じてウエハ表面側を先に洗浄し、裏面側を後に洗浄するようにしてもよい。

【００５３】そして、次にアドヒージョンユニット（ＡＤ）へ搬送され疎水化処理が行われ、次いでクーリングユニット（ＣＯＬ）にて所定の冷却処理が行われる。その後、レジスト塗布処理ユニット（ＣＯＴ）に搬送され、レジストの回転塗布が行われる。そして、プリベーキングユニット（ＰＲＥＢＡＫＥ）で所定の加熱処理が行われ、クーリングユニット（ＣＯＬ）において冷却処理され、その後ウエハ搬送体２４によりインターフェース部１２を介して図示しない露光装置により露光処理が行われる。露光処理が終了した後は、ウエハＷは現像処理ユニット（ＤＥＶ）に搬送されて現像処理が行われ、エクステンションユニット（ＥＸＴ）を介してカセットＣＲに戻される。なお、現像処理後に、ポストベーキングユニット（ＰＯＢＡＫＥ）により加熱処理が行われる場合もある。

【００５４】次に、洗浄処理ユニット５０における洗浄処理について図８に示すフローを参照しながら説明する。

【００５５】先ず、スピンチャック７１にウエハＷが受け渡され、このウエハＷの周縁部を覆うようにカップＣＰが上昇する。次に２流体ノズル３６がウエハＷの中心上に位置するように、２流体ノズル３６及びリンスノズル３５が移動し（ステップ１）、図９（ａ）に示すように、この両ノズルの位置から洗浄液及びリンス液の吐出を開始するとともに、ウエハＷ周縁部へ径方向に両ノズルの移動が開始される（ステップ２）。また、これと同時にウエハＷの回転を開始する。なお、このウエハＷの回転開始については、洗浄液及びリンス液の吐出開始と同時でなくともこれより前に回転を開始させるようにしてもよい。

【００５６】次に、図９（ｂ）に示すように、２流体ノズル３６がウエハＷ周縁部付近に移動してきた場合に、この２流体ノズル３６から吐出された洗浄液がカップＣＰの内側で跳ね返り、ミスト状となってウエハＷの中心側へ向けて飛散する。しかし、ここでリンスノズル３５によりリンス液をウエハＷに供給して親水性の液膜、すなわち水膜５１を形成しているため、カップＣＰに付着したパーティクルを含むミストが水膜５１上に付着することになる。しかし、水膜５１上にミストが付着してもウエハ面に直接ミストが付着するわけではないので、ウエハＷに悪影響を及ぼすおそれがなく、また、この水膜５１上に付着したミストは回転するウエハＷの遠心力に

よりリンス液とともにカップＣＰの下方に排出されるので問題はない。

【００５７】この後、図９（ｃ）に示すように、２流体ノズル３６がウエハＷ周縁部より外側に位置したら、洗浄液及びリンス液の吐出を停止し（ステップ３）、両ノズル３５，３６をカップＣＰの外側に配置させ、次に図９（ｄ）に示すように、例えばウエハＷを４０００ｒｐｍの回転数で回転させてウエハ上の液を振り切り、乾燥処理を行う（ステップ４）。

【００５８】ここで本実施形態においては、リンス液の流量、両ノズル３５及び３６の移動速度、ウエハＷの回転数は、それぞれ以下に示す通りであり、それぞれ一定の値とした。

リンス液の流量	１．０　ｌ／ｍｉｎ
両ノズルの移動速度	６　ｍｍ／ｓｅｃ
ウエハの回転数	１３００　ｒｐｍ

前述したように本実施形態では、ウエハＷの回転数は１３００ｒｐｍとしたが、これより小さくても大きくてもよい。しかし、ウエハ回転数を３００ｒｐｍより小さくすると、ウエハが疎水性の場合にはウエハ上全面に液膜を形成することができず、多数の水玉がウエハ面上に散在する状態となってしまうので、３００ｒｐｍ以上とすることが必要である。

【００５９】以上のように、本実施形態によれば、ウエハ上に親水性の液膜５１を形成させながら洗浄液を吐出して洗浄を行っているので、疎水性のウエハであってもパーティクルの付着を防止することができる。

【００６０】また、移動して洗浄液を吐出する２流体ノズル３６のウエハ中心側に、リンスノズル３５を配置し、洗浄液がウエハに供給される位置よりもウエハ中心側にリンス液を供給するようにしたので、例えば図９（ｂ）～（ｃ）に示すように、２流体ノズル３６がウエハ周縁部から外側に外れていく場合であっても、２流体ノズル３６に近接したリンスノズル３５は、常にウエハ周縁部にリンス液を供給して液膜を形成している。従って、特にカップＣＰからの跳ね返りミストが多いウエハ周縁部にパーティクルが付着することを防止できる。

【００６１】ここで、図１０～図１３を参照して、従来のように２流体洗浄液の吐出のみによる洗浄処理と、本実施形態のようにリンス液を供給して液膜を形成した場合の洗浄処理とにおける、それぞれウエハ面上のパーティクルの除去率（図１０，１１）及び増加量（図１２，１３）を比較してみる。ウエハの種類は親水性と疎水性とについて実験を行った。また、図１０～図１４において横軸は２流体ノズルにおける窒素ガスの流量であり、「Ｎｌ」の「Ｎ」とは、標準状態を表す。

【００６２】図１０は、親水性のウエハについて示しており、リンス液供給の有無でパーティクルの除去率はほぼ同一であり、親水性のウエハについては洗浄性能に変化はない。ところが、図１１に示すように疎水性のウエハにおいては、リンス液の供給の有無で、特に、窒素ガスの流量が６０Ｎｌ／ｍｉｎ以上においてパーティクルの除去率に顕著な差が生じた。この結果より、窒素ガスの流量は６０Ｎｌ／ｍｉｎ～１００Ｎｌ／ｍｉｎとすることが好ましく、特に８０Ｎｌ／ｍｉｎの場合に最もパーティクルの除去率が高いことが分かる。

【００６３】また、図１２及び図１３は、窒素ガス流量に対するウエハ１枚上のパーティクルの増加量を示しており、実質的な内容はそれぞれ図１０及び図１１と同様である。

【００６４】次に図１４を参照して、リンスノズル３５のウエハ上の移動途中において、リンス液の流量、リンスノズル３５の移動速度（＝２流体ノズルの移動速度）又はウエハＷの回転数を動的に可変する場合について説明する。

【００６５】例えば、リンス液の流量を可変とし、リンスノズル３５の移動速度及びウエハ回転数を一定とする場合、ウエハＷの周縁部に供給されるリンス液の流量を、ウエハ中心部に供給されるリンス液の流量よりも多くする。一実施形態として図１４（ａ）に示すように、例えば中心部で０．５ｌ／ｍｉｎとし、周縁部で１．２ｌ／ｍｉｎとしている。この場合、ウエハＷの周速度がその中心部と周縁部とで異なるが、このようにリンス液の流量を変えることで、ウエハ面上の単位時間当りに供給されるリンス液の供給量を中心部と周縁部とで可及的に同じにすることができる。なお、この場合、リンスノズル３５の移動途中において例えば２段階で供給量を可変してもよいし、３段階以上で徐々に０．５ｌ／ｍｉｎから１．２ｌ／ｍｉｎまで可変してもよい。

【００６６】次に、リンスノズル３５の移動速度を可変とし、リンス液の供給量及びウエハ回転速度を一定とする場合、ウエハＷの周縁部にリンス液が供給されるときのリンスノズル３５の速度を、ウエハ中心部に供給されるときのリンスノズル３５の速度よりも小さくする。一実施形態として図１４（ｂ）に示すように、例えば中心部で７ｍｍ／ｓｅｃとし、周縁部で５ｍｍ／ｓｅｃとしている。この場合、ウエハＷの周速度がその中心部と周縁部とで異なるが、このようにリンスノズル３５の移動速度を変えることで、ウエハ面上の単位時間当りに供給されるリンス液の供給量を中心部と周縁部とで可及的に同じにすることができる。なお、このリンスノズル３５の移動途中において例えば２段階で移動速度を可変してもよいし、３段階以上で徐々に７ｍｍ／ｓｅｃから５ｍｍ／ｓｅｃまで可変してもよい。

【００６７】次に、ウエハＷの回転数を可変とし、リンスノズル３５の移動速度及びリンス液の供給量を一定とする場合、ウエハＷ周縁部にリンス液が供給されるときのウエハ回転数を、ウエハ中心部にリンス液が供給されるときの回転数よりも小さくする。一実施形態として図１４（ｃ）に示すように、例えば中心部で１５００ｒｐ

ｍとし、周縁部で１０００ｒｐｍとしている。この場合、ウエハ面上の単位時間当りに供給されるリンス液の供給量を中心部と周縁部とで可及的に同じにすることができる。なお、このリンスノズル３５の移動途中において例えば２段階て回転数を可変してもよいし、３段階以上で徐々に１５００ｒｐｍから１０００ｒｐｍまて可変してもよい。

【００６８】以上のように、リンスノズル３５のウエハ上の移動途中において、リンス液の流量、リンスノズル３５の移動速度又はウエハＷの回転数を動的に可変することにより、ウエハの全面について洗浄性能を均一にできる。

【００６９】次に、図１５～図１８を参照して、第２のリンスノズル８３を使用した場合の洗浄処理について説明する。

【００７０】図１５においては、第１のリンスノズル３５を使用せず、２流体ノズル３６のみをウエハＷの径方向に中心部から周縁部まで移動させながら洗浄液を吐出しつつ、第２のリンスノズル８３によりリンス液を所定の位置、例えばウエハＷの中心部に供給し、液膜５１を形成している。これにより、２流体ノズル３６がウエハ周縁部まで移動した際に発生するカップ跳ね返りミストがウエハＷに直接付着することを防止できる。

【００７１】図１６においても第１のリンスノズル３５を使用していない。先ず、図１６（ａ）に示すように、ウエハ中心部に２流体ノズル３６から洗浄液を吐出しつつ中心部から周縁部へ移動させていくが、この時点では第２のリンスノズル８３からリンス液を吐出していない。これは、図１６（ａ）に示すように、２流体ノズル３６がウエハＷの中心位置から洗浄液の吐出を開始した時点では、洗浄液がカップＣＰに跳ね返ることが少ないからである。そして次に、図１６（ｂ）に示すように、２流体ノズル３６がウエハＷの周縁部付近まで移動したときに、カップ跳ね返りのミストが増加するため、この時にリンス液を供給し液膜５１を形成することにより、跳ね返りミストの付着を防止できるとともに、図１５における場合に比べリンス液の使用量を削減できる。

【００７２】図１７（ａ）及び図１７（ｂ）においても第１のリンスノズル３５を使用していない。先ず図１７（ａ）に示すように、２流体ノズル３６から洗浄液を吐出しつつ中心部から周縁部へ移動させるとともに、リンス液供給により液膜５１を形成する。そして、図１７（ｂ）に示すように、２流体ノズル３６が周縁部に来たときに、第２のリンスノズル８３のリンス液の吐出角度を変えることにより、洗浄液が吐出される位置に合わせて、リンス液の供給位置をウエハ周縁部付近にすることにより、より確実にウエハ周縁部でのミストの付着を防止できる。

【００７３】図１８は、第１、第２のリンスノズル３６、８３の両方を使用している。この場合、２流体ノズル３６及び第１のリンスノズル３５が中心部から周縁部への移動しつつ洗浄液及びリンス液を吐出し、更にこれに加えて第２のリンスノズル８３からもリンス液を供給している。これにより、ウエハＷ全面に確実に液膜５１を形成でき、ミストの付着を確実に防止できる。

【００７４】図１９及び図２０は、一実施形態に係る洗浄処理システムの全体構成を示す平面図及び正面図である。なお、図１９及び図２０において、図１及び図２における構成要素と同一のものについては同一の符号を付すものとし、その説明を省略する。

【００７５】処理ステーション１１の正面側には、ウエハＷの洗浄のための洗浄処理ユニット５０が４台、中央部に主ウエハ搬送機構２２が配設されている。この主ウエハ搬送機構２２に隣接して、洗浄後の乾燥に必要な熱処理ユニット（ＨＰ）及び冷却処理ユニット（ＣＯＬ）９１、ウエハＷをカセットステーション１０と処理ステーション１１との間で受け渡すトランジションユニット（ＴＲＳ）及びウエハＷの表裏を反転させるリバースユニット（ＲＶＳ）９０が配設されている。また処理ステーション１１の背面側には、洗浄処理システム２全体の動作・制御を行うための電装ユニット（ＥＢ）９３と機械制御ユニット（ＭＢ）９４、洗浄処理ユニット５０で使用される所定の洗浄液を貯蔵する薬液貯蔵ユニット（ＣＴＢ）９２が配設されている。更に、処理ステーション１１には、その天井部より清浄な空気をダウンフローするためのファンフィルタユニット（ＦＦＵ）９５が配設されている。

【００７６】このような洗浄処理システム２は、上記塗布現像処理システム１以外の工程における洗浄専用システムとして用いることができる。例えば、塗布現像工程以外の工程としては、特定ガス、又は数種の化合物ガスをウエハＷ上に供給し、ウエハＷ表面での化学反応により所望の薄膜を形成させるＣＶＤ工程、ウエハＷ表面上に形成された薄膜の全面又は特定部分を必要な厚さだけ食刻するエッチング工程等があるが、これらＣＶＤ工程又はエッチング工程の処理中に汚染したウエハを洗浄するための専用処理システムとして用いることができる。

【００７７】なお、本実施形態では、洗浄処理システム２を単体のシステムとして説明したが、上記のＣＶＤ工程で使用するＣＶＤ装置や、エッチング工程で使用するエッチング装置等と、洗浄処理システム２とをインターフェース装置等を介して接続し、インライン化された複合装置として使用することができる。

【００７８】本発明は以上説明した実施形態には限定されるものではなく、種々の変形が可能である。

【００７９】例えば、図９（ａ）、（ｂ）に示す洗浄処理工程において、２流体ノズル３６がウエハＷの中心位置から洗浄液の吐出を開始するときに、リンスノズル３５からのリンス液の吐出は行わず、例えば図９（ｂ）に示すように、２流体ノズル３６がウエハ周縁部に来た時

にカップ跳ね返りミストが増加するため、図１６（ａ）、（ｂ）に示す場合と同様にリンス液を供給するようにしてもよい。これは、２流体ノズル３６がウエハＷの中心位置から洗浄液の吐出を開始した時点では、洗浄液がカップＣＰに跳ね返ることは少なく、２流体ノズル３６がウエハＷの周縁部付近まで移動したときに、跳ね返りのミストが発生しやすい状態となるからである。これにより、リンス液の使用量を削減することができる。

【００８０】また、図１５、図１６（ａ）、（ｂ）及び図１８において、リンスノズル８３からのリンス液は、ウエハ中心部に供給するようにしたが、２流体ノズル３６による洗浄液と干渉しない供給位置ならば、ウエハ中心部に限られない。

【００８１】更に、上記実施形態では、基板として半導体ウエハを使用したが、これに限らず、液晶ディスプレイ等に使用されるガラス基板についても本発明は適用可能である。

【００８２】

【発明の効果】以上説明したように、本発明によれば、基板の親水性又は疎水性に関わらず、ミスト発生に起因するパーティクルの付着を防止し、洗浄性能を向上させることができる。

【図面の簡単な説明】

【図１】本発明の一実施形態に係る塗布現像処理システムの平面図である。

【図２】図１に示す塗布現像処理システムの正面図である。

【図３】図１に示す塗布現像処理システムの背面図である。

【図４】本発明の一実施形態に係る洗浄処理ユニットの平面図である。

【図５】図４に示す洗浄処理ユニットのＸ方向から見た断面図である。

【図６】図４に示す洗浄処理ユニットのＹ方向から見た断面図である。

【図７】一実施形態に係る２流体ノズルの断面図である。

【図８】一実施形態に係る洗浄処理工程を示すフロー図である。

【図９】一実施形態に係る洗浄処理工程を順に示す側面図である

【図１０】リンス液供給の有無で親水性ウエハのパーティクル除去率を比較した図である。

【図１１】リンス液供給の有無で疎水性ウエハのパーティクル除去率を比較した図である。

【図１２】リンス液供給の有無で親水性ウエハのパーティクル増加率を比較した図である。

【図１３】リンス液供給の有無で疎水性ウエハのパーティクル増加率を比較した図である。

【図１４】ウエハ中心部と周縁部とにおいて、リンス流量、リンスノズル移動速度又はウエハ回転数をそれぞれ可変した場合の各値の一例を示す図である。

【図１５】２流体ノズルと第２のリンスノズルとを使用した場合の側面図である。

【図１６】図１５において、２流体ノズルの移動途中からリンス液を供給した場合の側面図である。

【図１７】２流体ノズルを吐出角度を可変した場合の側面図である。

【図１８】第１及び第２のリンスノズルの両方を使用した場合の側面図である。

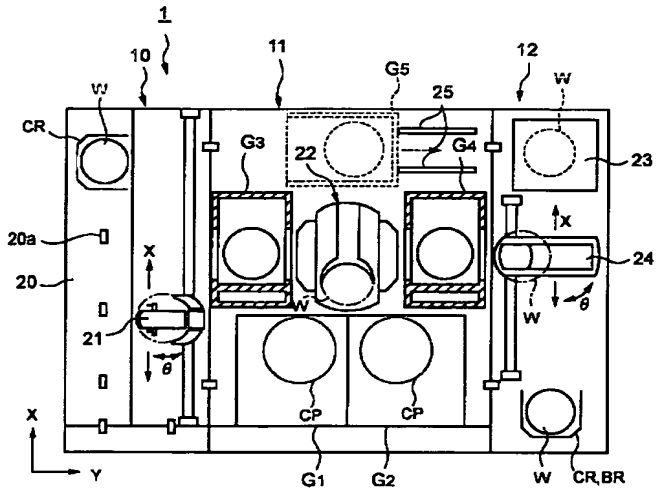
【図１９】一実施形態に係る洗浄処理システムの全体構成を示す平面図である。

【図２０】図１９に示す洗浄処理システムの全体構成を示す正面図である。

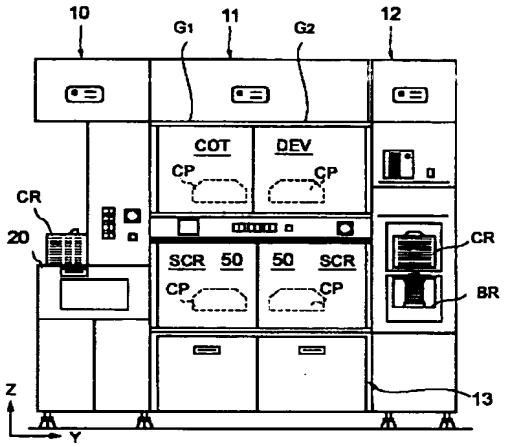
【符号の説明】

Ｗ…半導体ウエハ
１…塗布現像処理システム
３１…駆動ブーリ
３２…ベローズポンプ
３３…制御系
３４…ガイドレール
３５…第１のリンスノズル
３６…２流体ノズル
３８…ステッピングモータ
３９…リンス液供給源
４０…連結部材
４１…ベルト
４３…供給管
５０…洗浄処理ユニット
５１…液膜
７１ａ…チャックプレート
７１ｂ…枢軸
７１ｃ…回転駆動モータ
７１ｄ…脱着機構
７２…連結テーブル
７７…ノズル保持アーム
８３…第２のリンスノズル

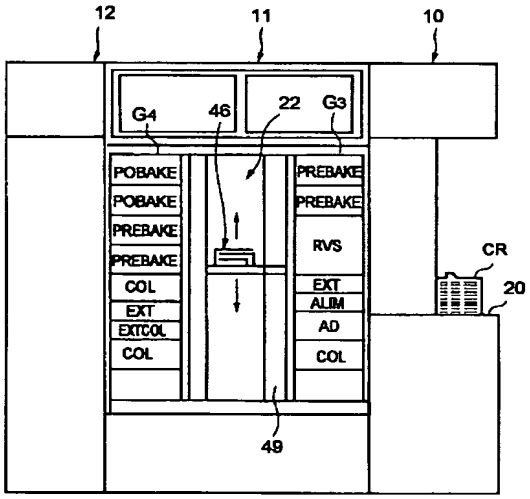
【図１】



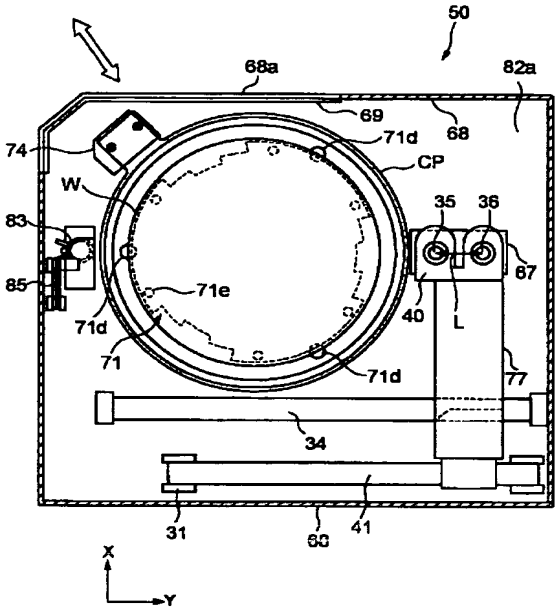
【図２】



【図３】

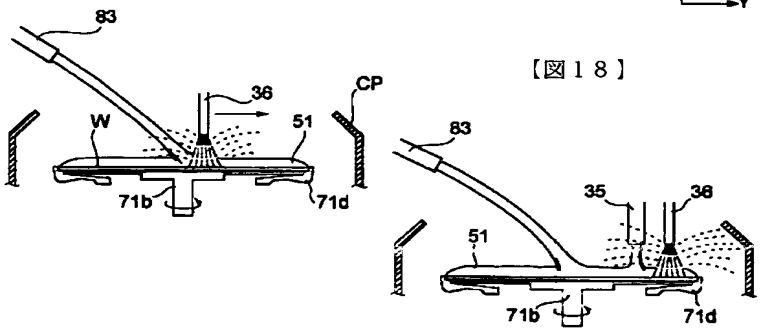


【図４】

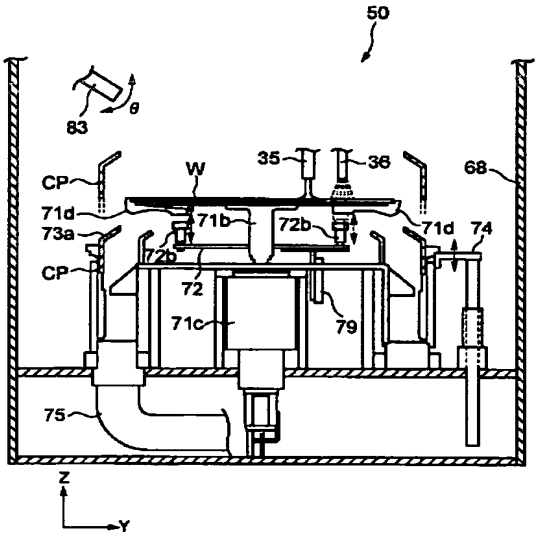


【図１５】

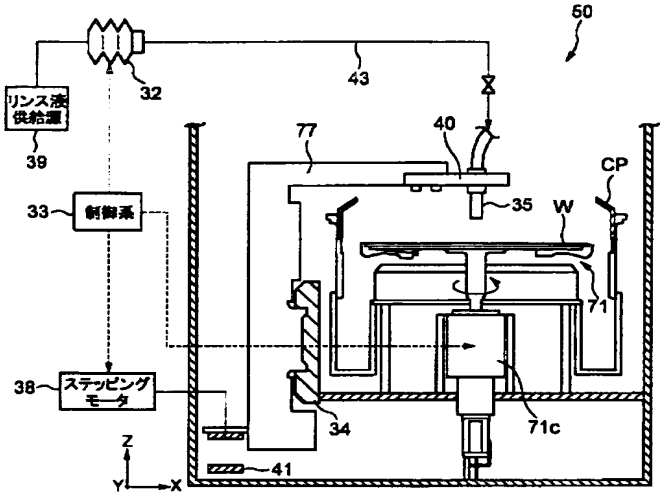
【図１８】



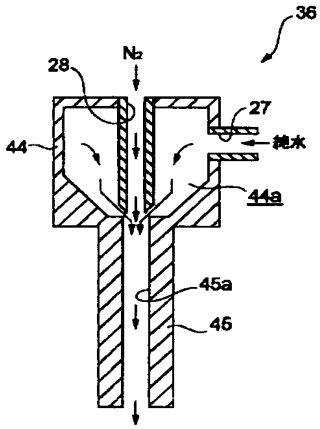
【図５】


50
83
θ
CP
W
35
36
68
71d
73a
71b
72b
71d
74
72b
72
CP
71c
79
75
Z
Y

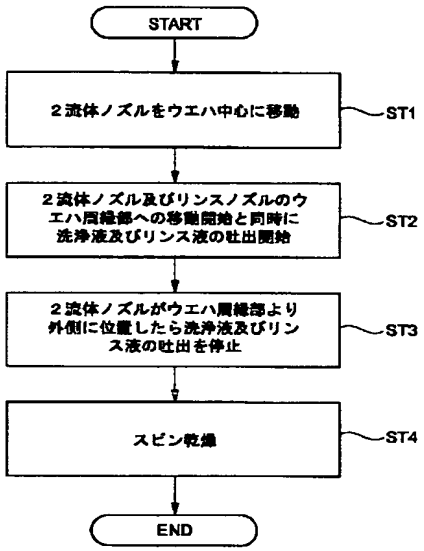
【図６】


50
32
43
リンス液供給源
39
77
40
CP
33
制御系
35
W
71
38
ステッピングモータ
34
71c
Z
Y
X
41

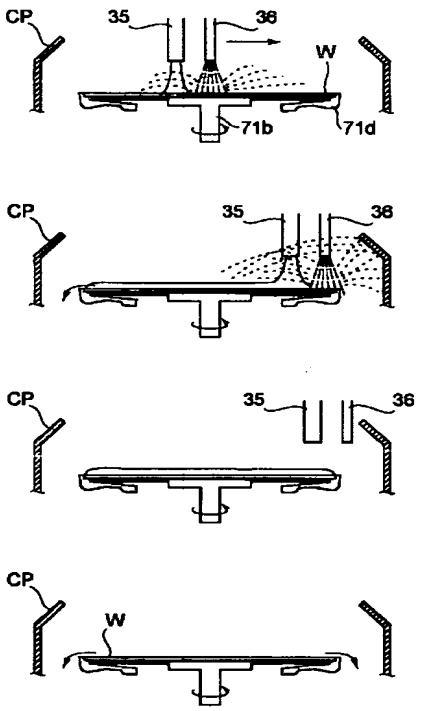
【図７】


36
N2
28
27
44
純水
44a
45a
46

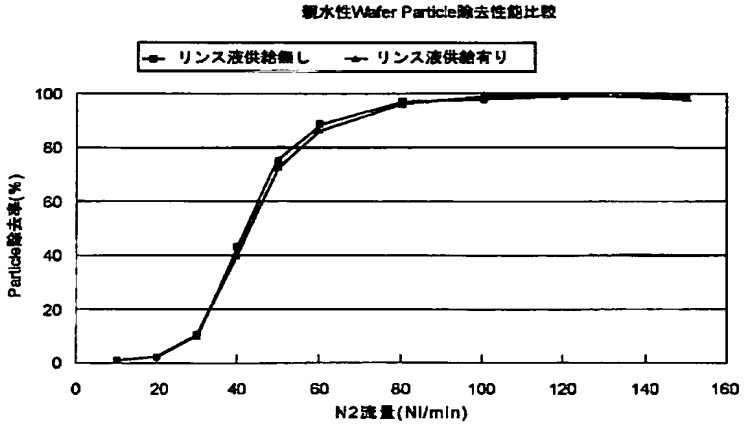
【図８】


START
２流体ノズルをウエハ中心に移動
ST1
２流体ノズル及びリンスノズルのウエハ周縁部への移動開始と同時に洗浄液及びリンス液の吐出開始
ST2
２流体ノズルがウエハ周縁部より外側に位置したら洗浄液及びリンス液の吐出を停止
ST3
スピン乾燥
ST4
END

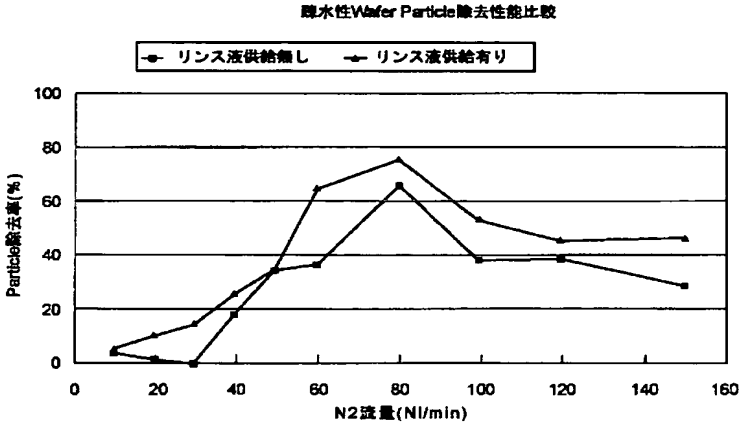
【図９】


(a)
CP
35
36
W
71b
71d
(b)
CP
35
36
(c)
CP
35
36
(d)
CP
W

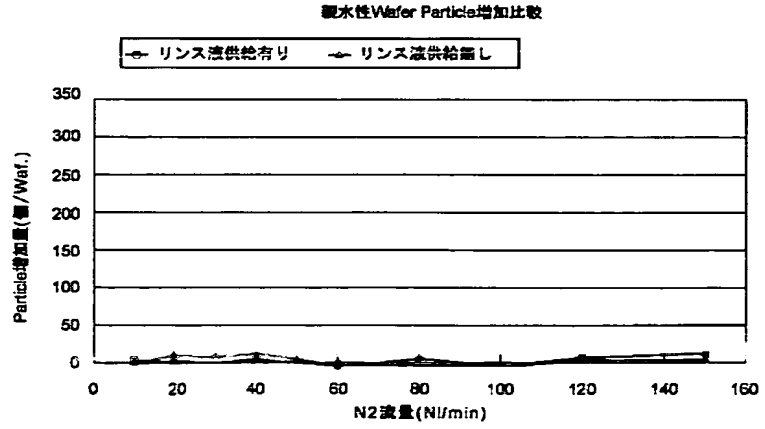
【図１０】



【図１１】



【図１２】



【図１４】

リンス液流量

(a)

ウエハ中心部	0.5 l/min
ウエハ周縁部	1.2 l/min

リンスノズル移動速度

(b)

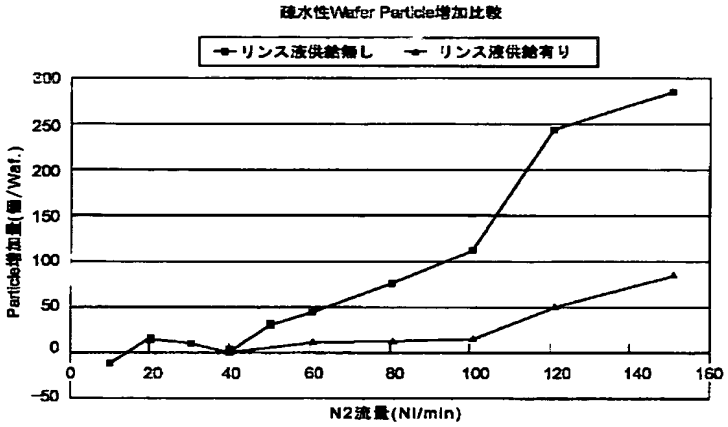
ウエハ中心部	7 mm/sec
ウエハ周縁部	5 mm/sec

ウエハ回転数

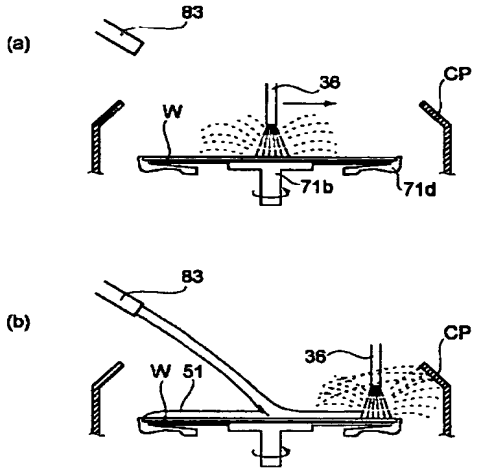
(c)

ウエハ中心部	1500 rpm
ウエハ周縁部	1000 rpm

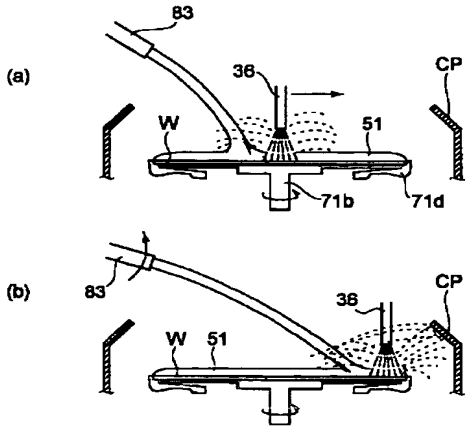
【図１３】



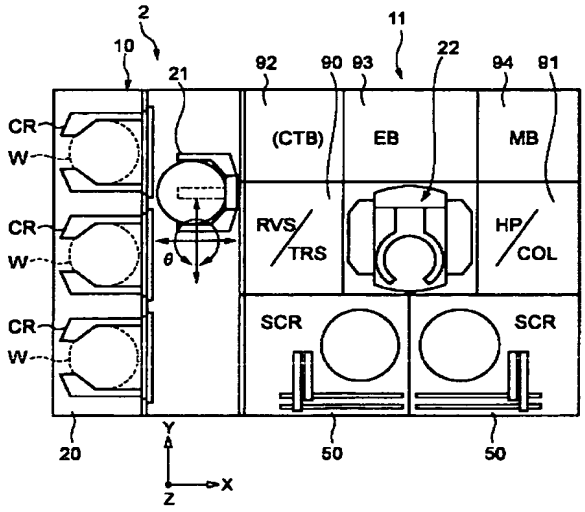
【図１６】



【図１７】



【図１９】



【図２０】